MECHANICAL ENGINEERING

· AUGUST 1950 ·

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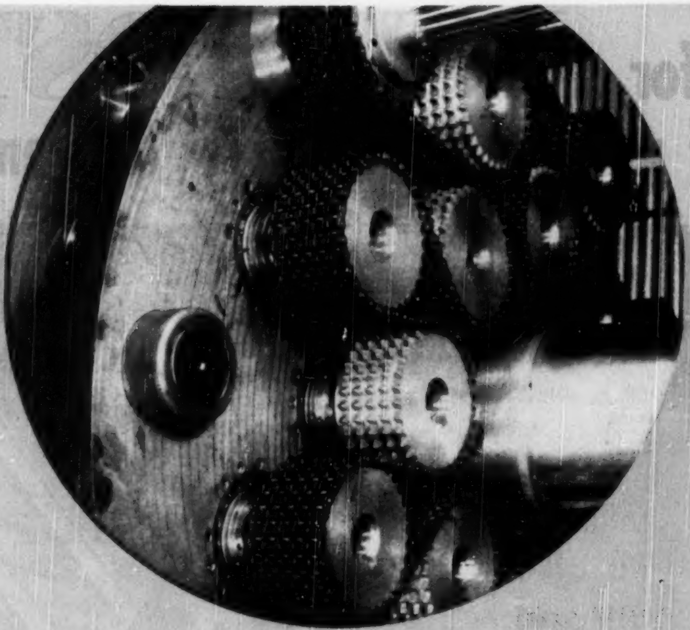


Flexibility and ability to drive any number of shafts efficiently is clearly shown in this close-up illustration of Link-Belt Precision Steel Roller Chains and Sprockets driving spindles on automatic drilling and forming machine.

there's never a slip

with a LINK-BELT GRIP

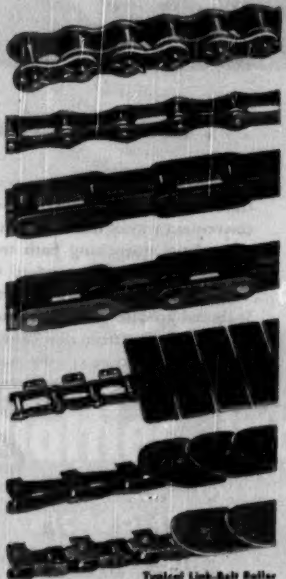
Positive transmission of power and efficient conveying with compactness, wide flexibility of arrangement and ability to absorb shock are characteristics of roller chain, which are enhanced by the precision manufacturing methods and metallurgical control followed in the huge Link-Belt chain plant.

Link-Belt Precision Steel Roller Chain and Sprockets are available immediately, in single or multiple widths, in ⅜" to 2½" pitch. Also, with various types of attachments, as well as the double pitch and flat-top, crescent flat-top and universal flat-top chains. Made to manufacturers' A.S.A. standards.

11,917-A

LINK-BELT
PRECISION STEEL
ROLLER CHAINS
AND SPROCKETS

THE SYMBOL OF QUALITY LB LINK-BELT

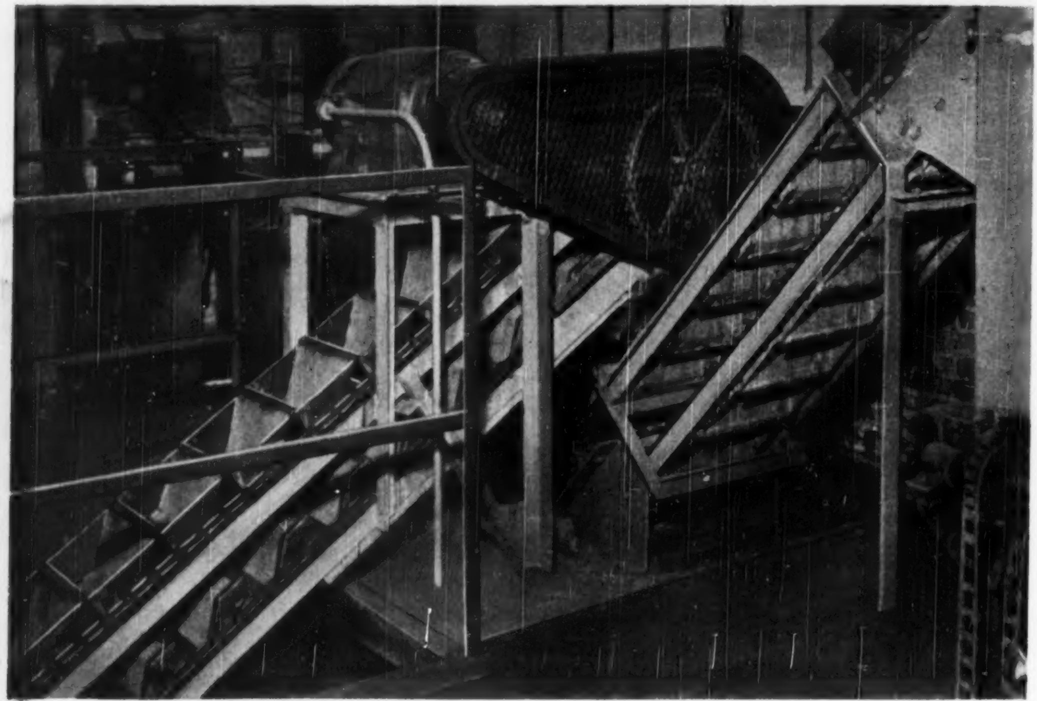


Typical Link-Belt Roller Chains for Conveying and Power Transmission

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices, Factory Branch Stores and Distributors in Principal Cities.

for a LOW COST method of moving parts through quenching baths



. . . use this Standard G-W Conveyor

One of the country's largest manufacturers of electrical equipment wanted a low cost, simple and convenient way of moving quenched screw machine parts from quenching bath to acid dip. Gifford-Wood supplied the standard Quench Tank Conveyor system shown above. Metal screen pans were included to allow the parts to drain thoroughly while traveling from one bath to the other.

This installation is only one of many types of Gifford-Wood conveyor systems found working successfully in all fields of industry. G-W's specialized engineering knowledge and experience, applied to your production problems, will help reduce handling costs in manufacturing operations. Why not call on G-W? We'll survey your present system, make suggestions and preliminary layouts that will point the way to simplifying *your* materials handling problem . . . insure more economical operation.

GIFFORD-WOOD CO.

Since 1814

Hudson, New York

NEW YORK 17, N. Y.	ST. LOUIS 1, MO.	CHICAGO 6, ILL.
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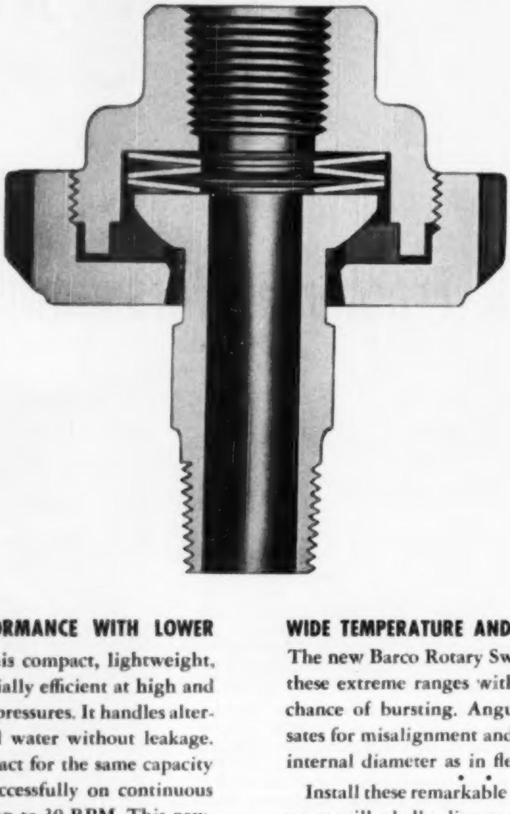
6774

When You Think of Materials Handling—Think of GIFFORD-WOOD

Improved Barco Rotary Swivel Joints

FOR MINIMUM FRICTION



FRICTION-FREE PERFORMANCE WITH LOWER TURNING TORQUE. This compact, lightweight, low cost joint is especially efficient at high and low temperatures and pressures. It handles alternating steam and cold water without leakage. It is much more compact for the same capacity and has performed successfully on continuous rotation applications up to 30 RPM. This new, low torque joint will greatly reduce power costs and worker fatigue. It is practically maintenance free.

WIDE TEMPERATURE AND PRESSURE RANGES. The new Barco Rotary Swivel Joints withstand these extreme ranges with complete safety, no chance of bursting. Angular motion compensates for misalignment and there is no restricted internal diameter as in flexible hose.

• • •

Install these remarkable joints now. Our engineers will gladly discuss your problems. Sizes 3/8", 1/2", 3/4", 1". When ordering, give complete information about pressures, temperatures, fluids or gases, and any other special conditions.

BARCO ***FLEXIBLE JOINTS***

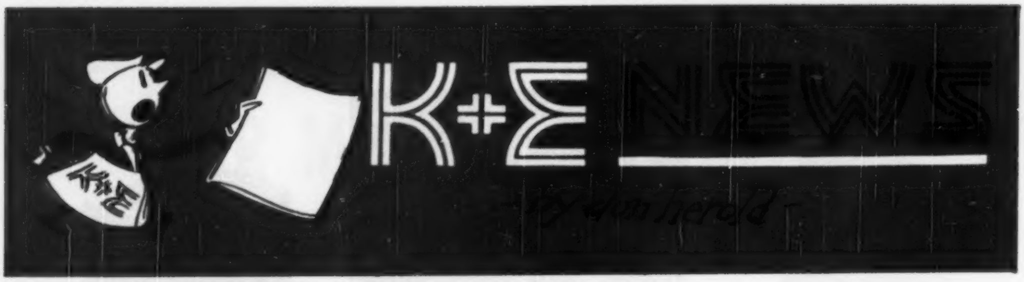
Not just a swivel joint ...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

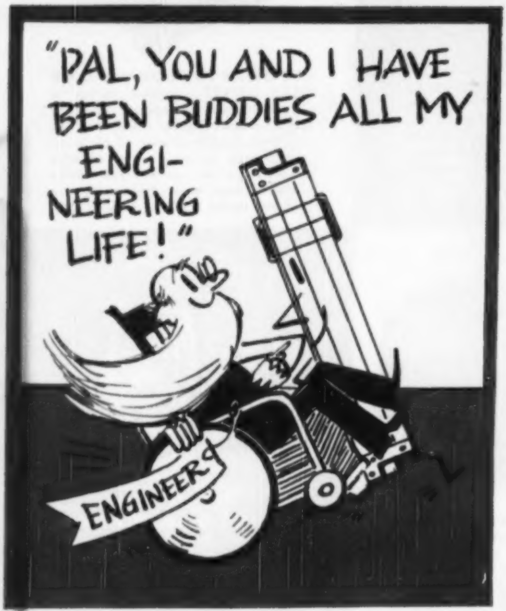
FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

"MOVE IN EVERY DIRECTION"

BARCO MANUFACTURING COMPANY,

18071 Winnemac Avenue, Chicago 40, Illinois • In Canada: THE HOLDEN CO., LTD., MONTREAL, CANADA





Down through the years with a K&E Slide Rule

Although K&E Slide Rules are the oldest slide rules made in America, there are no whiskers on 'em—except cat's whiskers (I mean, symbolizing precision).

If you are an old engineer, you probably regard your K&E Slide Rule as a priceless Stradivarius. You are probably figuring on passing it down to your grandchildren.

If you are a beginner, the sooner you attach yourself to an immortal K&E rule, the better.

K&E Slide Rules have become accepted symbols of the engineering profession. If a photographer, illustrator or cartoonist wants to indicate that his hero is a top-flight engineer, he puts a K&E Slide Rule in his hand or in the immediate environment.

Ask anybody what he knows about Keuffel & Esser, and he first starts rhapsodizing about slide rules. Slide rules and K&E are synonymous.

And they're both almost as long lasting as the pyramids!

Keuffel & Esser have been around since 1867 and they completed their first batch of slide rules in 1891.

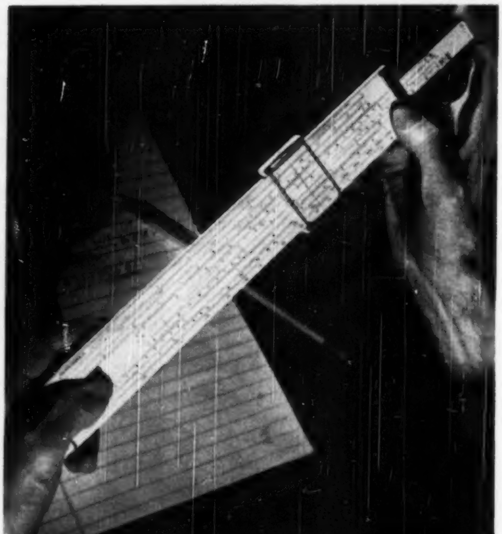
It is not uncommon to hear of a K&E rule which has been in service for over 50 years.

I used to think a slide rule was a slide rule—just as a yard stick is a yard stick—but there is a sensational variety of 'em in the K&E line—from the simple Mannheim to the more complicated brethren, such as the Log Log Duplex Trig and Decitrig and the Log Log Duplex Vector*.

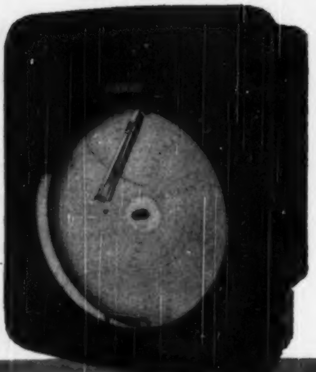
Also, there are several sizes from the handy pocket rules, to the more common 10-inch, up to the 20-inch longfellows.

There's no point to hitching up for life with a "second best" slide rule when you can play a Keuffel & Esser.

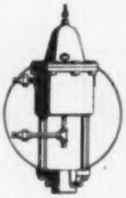
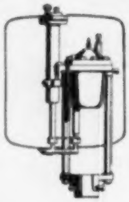
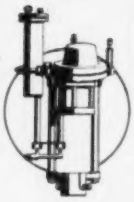
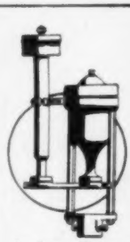
*Trade Marks ®



What's worth metering is worth metering right!



. . . and Foxboro offers the *right* meter for any metering problem. See the varied types below.

TYPES 1 & 2 Meter Body	TYPE 9 Meter Body	TYPE 17 Meter Body	TYPE 8 Meter Body	TYPE 6 Meter Body
				
light weight & low cost for indicators & portable recorders.	for differential ranges as low as 1" H_2O especially for low pressure gas and air service	Unequalled quality meter for general industrial service	longest float travel, greatest power, highest accuracy meter ever built	leakproof measurement at really high pressures without compromise in accuracy

a flow meter type for every need

From its complete line of flow meters, Foxboro can offer the *best* type — in the proper range and static pressure rating — for virtually any metering problem. They are available as indicators, recorders, controllers, and transmitters . . . known throughout industry for their accuracy, dependability, and economy.

The widest selection of flow instruments is only one of many factors responsible for Foxboro's acknowledged leadership in flow metering. See how this factor—together with many superior, exclusive design features — give you the most value for your money in flow metering. Write for Bulletin 351-2. The Foxboro Company, 182 Neponset Ave., Foxboro, Mass., U. S. A.

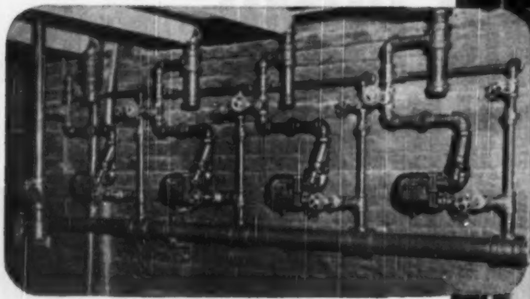
Specifications of Foxboro Meter Types Illustrated

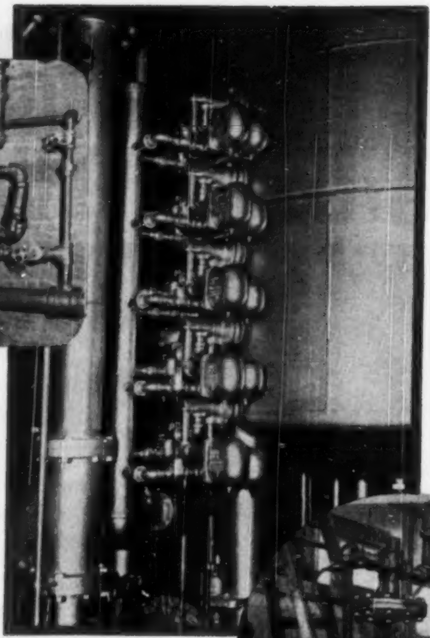
TYPE	MATERIAL	MAX. W. P.	RANGES
2	Forged Steel	1000	100"–200"
9	Cast Iron	150	1" –10"
17	Forged Steel	1800	10"–400"
8	Forged Steel	1500	50"–400"
6	Forged Steel	3500	100"–200"

FOXBORO FLOW METERS

REG. U. S. PAT. OFF.

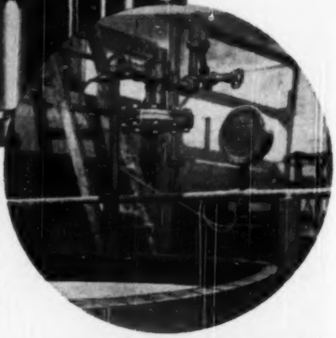
First we make sure of hot, dry steam at the inlet.





Then we select the best of four distinct types of steam traps to remove all condensate without steam waste.

GET YOUR STEAM SYSTEM *Rationalized* WITH SARCO

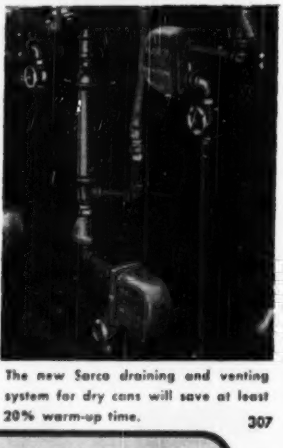


If automatic temperature control is indicated, Sarco can choose from a wide range of self-operated, pilot or electric controls to do the job at minimum cost.

Operating a steam process with maximum efficiency is more than buying a few steam traps and air vents—it is more than haphazardly applying a few temperature controls.

If it means dollars to you in increased production, improved quality and fewer rejects—it will pay you to let the Sarco man near you make a survey of your needs.

He will come up with definite, practical suggestions of how you can do a better job and save steam besides. Write today—there is no obligation.



The new Sarco draining and venting system for dry cans will save at least 20% warm-up time.

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SARCO SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

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SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT


D.A.*
An HONORARY DEGREE Conferred on
MIDWEST
WELDING ELBOWS
By Pipe Welders Everywhere
ASA Standard
Midwest "Long-Tangent"
Short Radius
Midwest Reducing
Pipe welders who know Midwest Welding Elbows have conferred upon them an honorary degree unique in piping . . . "D. A." for "dimensional accuracy".
This degree was earned for Midwest Elbows by their unique process of manufacture. In this process, developed by Midwest, the elbow is first made slightly oversize. After welding it is reheated to forging temperature and brought to final size in compression dies. This relieves forming and welding stress . . . assures true circular cross-section, controlled wall thickness and accurate radius, included arc and tangents. The elbows are beveled on special machines which cut both ends simultaneously, holding exact included angle and center-to-end dimensions.
"D. A." is a degree which means a lot to pipe welders. It means that they don't have to waste time lining up inaccurate fittings. It means that they don't have to spend time and weld metal in compensating for bad fit. And it means that they can produce better, cleaner, stronger welds with less trouble.
"D. A." saves money for you when it saves time and trouble for welders. Use Midwest "D. A." Elbows on your next job. Call your Midwest Distributor; there is one conveniently near you.
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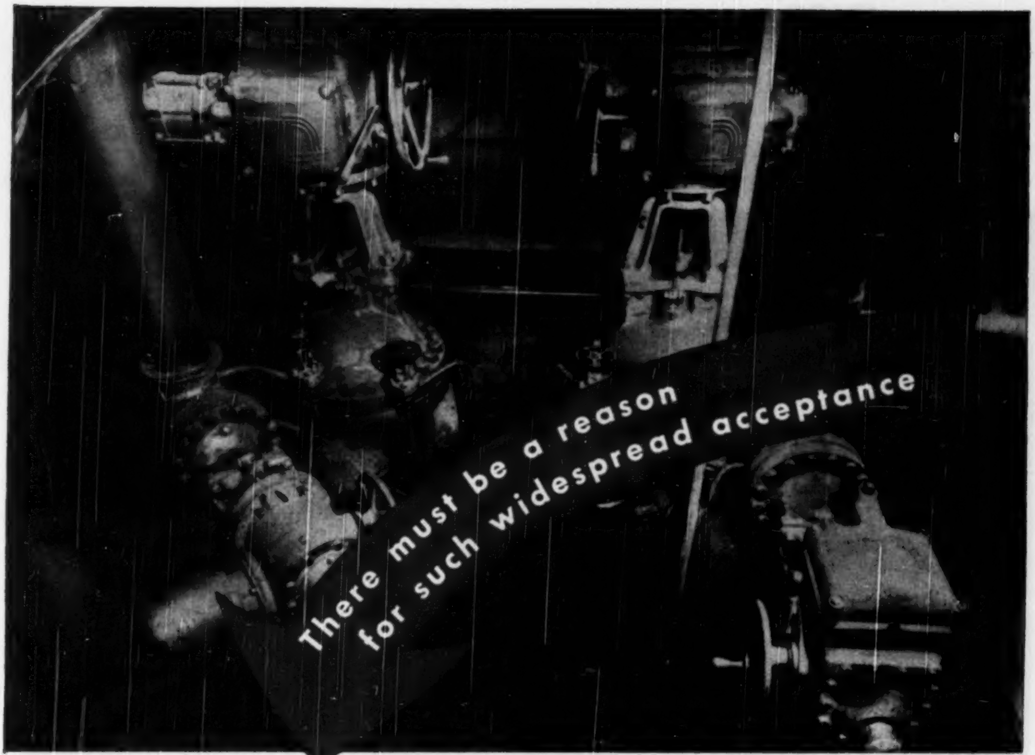
* Dimensional Accuracy



PHILADELPHIA ELECTRIC CO. uses hundreds of LimiTorque VALVE OPERATORS in 5 stations

Southwark . . . Waterside . . . Schuylkill . . . Richmond . . . Barbadoes . . . in all these 5 central stations of the Philadelphia Electric Co., LimiTorque Controls have been installed for the operation of valves of various types and sizes.

LimiTorque Remote Control enables one man to merely "push buttons" and actually see on a panelboard whether the valves are open or closed. Then too, there is the important safety factor afforded by LimiTorque Remote Control, because men do not have to go to high, low, dangerous or inaccessible locations to open and close valves. Further, LimiTorque prevents damage to seats, discs, stems, etc., because it "automatically" shuts-off the power, should an obstruction in closing occur.

LimiTorques are available for different requirements on all types of valves (globe, gate, butterfly, plug, etc.)—and may be supplied for actuation by any power source, such as electricity, steam, water, gas, oil or air. Your valve manufacturer can supply them.

Send for our catalog, and please use your Business Letterhead when requesting same.

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NEW YORK • PITTSBURGH • CHICAGO • HOUSTON
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers — LimiTorque Valve Controls

Installation Techniques are "Pay-off"...

With modern operating temperatures ranging as high as 1050°F. and pressures climbing upwards of 2,000 psig., welding and concurrent heat treating of alloy power piping *during installation* pose critical problems for field crews.

For example, the weld shown in the illustration required a heat treating cycle of over 15 hours. During this time Kellogg crews, using special induction heating equipment, raised the temperature of the weld area at a predetermined controlled rate over a period of some four hours. Upon reaching the proper pre-heat temperature, welding was started as shown in the picture.

As the weld was made the temperature was naturally held at a uniform level. Upon completion, the weld was stress-relieved at a predetermined elevated temperature for over two hours and then allowed to cool at a controlled rate for four hours to complete the cycle.

Over the years such special techniques in connection with welding alloy piping have been developed by Kellogg engineers, who have been entrusted with such recent innovations in power piping as the first HT-HP stainless steel installation and the fabrication of piping for the original 1050°F. station.

The experience of these well-trained field installation crews is one "plus value" obtained when power piping by M. W. Kellogg is specified.

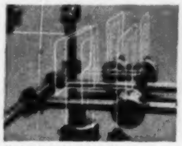
Illustrated—Inspector checks laying of first bead.

M. W. KELLOGG

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

M KELLOGG W



Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Vessels
Exchangers
Condensers
Process Piping
Forged and Welded Fittings
Radial Brick Chimneys

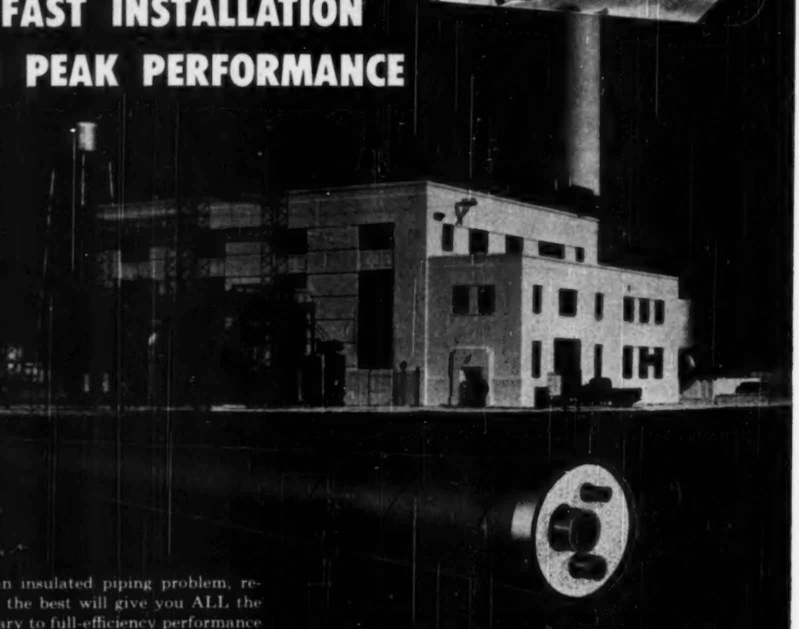
★

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman Incorporated) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris

RIC·WIL GIVES YOU

3-WAY EFFICIENCY

...IN SYSTEM DESIGN
...IN FAST INSTALLATION
...IN PEAK PERFORMANCE



When you have an insulated piping problem, remember that only the best will give you ALL the advantages necessary to full-efficiency performance of your system. That means Ric-wiL Prefabricated Insulated Piping.

Ric-wiL provides all the factors that insure (1) top-efficiency system design; (2) fast, economical installation; (3) the right protection and insulation for the job.

Ric-wiL maintains a competent Piping Engineering staff for assistance to architects, engineers, and contractors in the planning of insulated piping systems and preparation of accurate, time-saving installation drawings.

Ric-wiL prefabricated straight sections and complete line of accessories provide fast, economical installation by eliminating the many inefficiencies of field fabrication of insulating and protective materials.

Peak operating performance is constantly insured in Ric-wiL systems by the fine material and workmanship used in producing Ric-wiL products. From the raw material stage through every phase of fabrication, skilled craftsmen build into Ric-wiL piping every known component for long, efficient operating life.

And remember this . . . only Ric-wiL provides all the features necessary to maximum protection, insulation, and high efficiency operation of underground or overhead insulated piping systems.

The Ric-wiL representative nearest you will be glad to give you full information on Ric-wiL as applied to your problem. If you prefer, write to Dept. 14-OA at Cleveland, Ohio, for full technical information.

40th YEAR DEPENDABLE INSULATED PIPING SYSTEMS

RIC·WIL

INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY · CLEVELAND, O.

OVERHEAD UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

They're New!

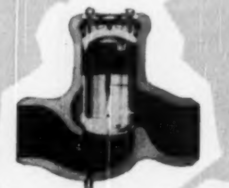
NEW PRESSURE SEAL BONNET VALVES.. NEW FORGED STEEL GLOBE VALVES.. NEW IMPACTOR HANDWHEELS..

SELF-SEALING BONNET JOINTS, 30% MORE FLOW

Now you can get Edward pressure-seal bonnet valves in gate, globe or angle patterns for stop, check or non-return service. New features for lower and lower pressure drop have been built in—and proved. On no other valve series is there more proven flow data.

EDWARD PATENTED EVALTHRUST YOKE BUSHING

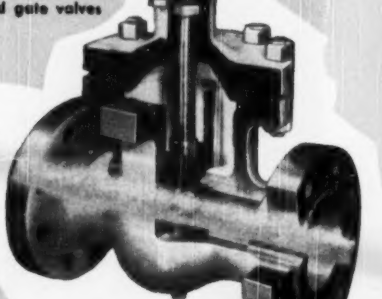
and Impactor handwheel for easiest closing in cramped locations is standard on stop and non-return series. So is closure indicator.



ON CHECK VALVE, left, and non-return valve, far left, note new enclosed dash-pot disk, Edward Equalizer for high disk lift and free flow passage. The whole series is regularly built in chrome-moly steels for stability at high temperatures.

GATE VALVE THAT STAYS TIGHT

Welded-in Stellited seats, welded-in guide ribs to eliminate wedge drag on seating faces, ball bearing operation clear down to 4 or 5 in. sizes—these and many other features are standard—not added cost extras—in the new Edward gate valves



WANT MORE DATA? Special bulletins are now available on most of these designs. A few are so new that full catalog data isn't ready yet, but we can supply dimensional drawings. Ask your nearest Edward representative, or write direct to Edward Valves, Inc., East Chicago, Indiana.

New World's Record! Nelson Higgins of Pullman, Wash., beat the previous world record by nearly three pounds when he caught this 32-pound Dolly Varden at Lake Pend Oreille, Idaho, on Monel line.

How to catch fish when they're not biting

Fishermen used to have a devil of a time hooking fish like this in hot weather.

Trouble was that big fish like to stay way down on the cool lake bottom. Ordinary trolling line just wouldn't go down there.

All sorts of gadgets were tried. Trick sinkers and attachments were devised to get the hook down where the fish could grab it. The lines themselves were coated with heavy substances to make them sink.

Finally, *metal* lines were given a trial. They went down all right. But other difficulties came up.

They were too heavy. Too thick, too awkward altogether. To be flexible enough for easy handling, the wire line had to be light and fine. To be fine, the metal had to be very strong.

The metal also had to be rustless . . . corrosion-resisting . . . and tough to stand the twisting, diving, leaping yanks of a fighting fish.

Then the news came down from the "big muskie" lakes of Canada about the discovery of a line that revolutionized deep trolling: MONEL Line.

Today, wherever you see fresh water and salt water fishermen trolling for the big ones 'way down deep, you find them using Monel lines . . . and catching the biggest fish of all in the hot summer months when fishing used to be "dead."

Perhaps like the manufacturers of trolling line, your problem is one of wire. If it is, send for the new folder "IF WIRE HAS YOU SNARLED." *Contains helpful information on the properties of Monel, Nickel and Inconel® wire. And if you're interested in fishing, send for your free copy of our 44-page booklet,* "HOW TO CATCH FISH WHEN THEY'RE NOT BITING."

INCO Nickel Alloys

Monel® • "R"® Monel • "K"® Monel • "KR"® Monel
"S"® Monel • Inconel® • Nickel • "L"® Nickel
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EMBLEM OF SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

MECHANICAL ENGINEERING

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VOLUME 72 NUMBER 8

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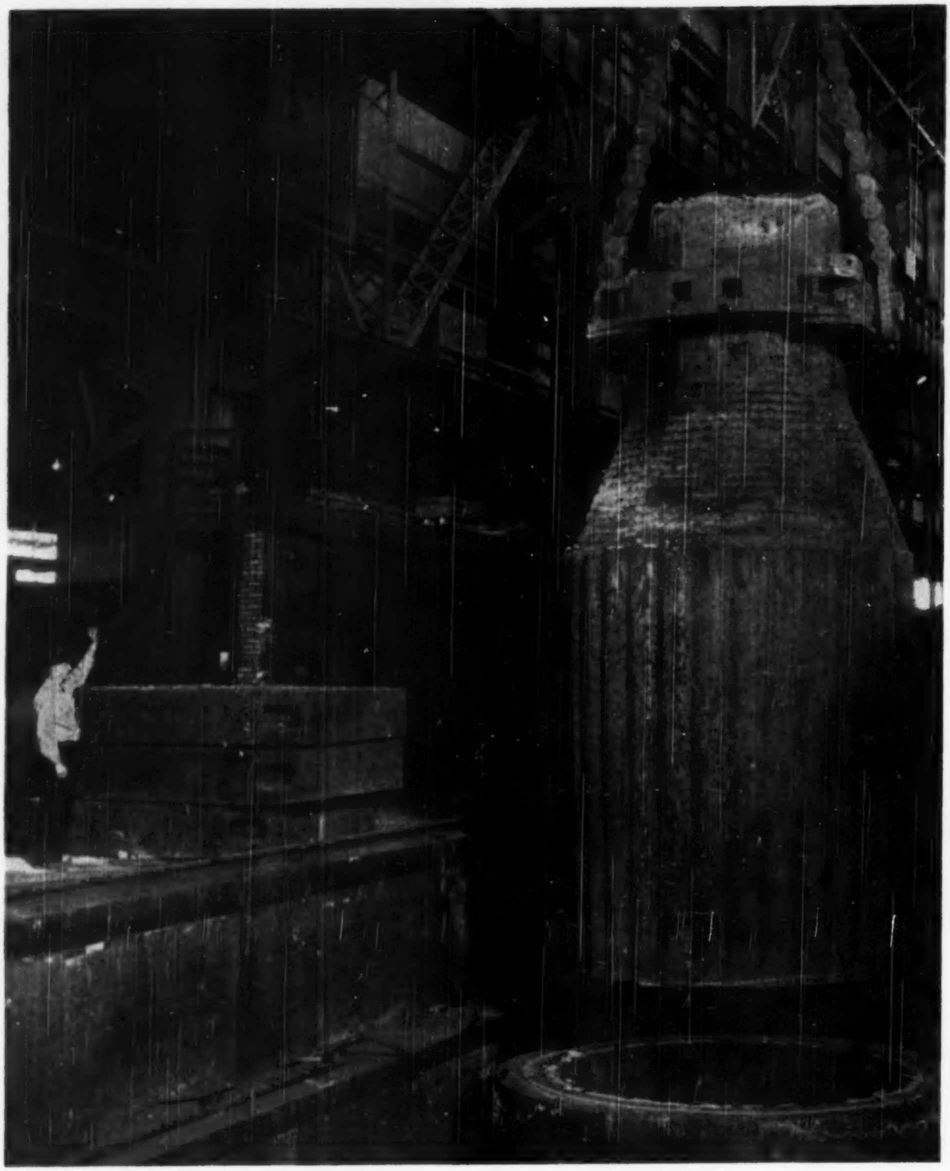

A 110-In-Diam Forging Ingot for a Generator Shaft Is Shown Being Stripped From the Mold

(This ingot weighs between 400,000 and 500,000 lb with 25 per cent of its weight in the hot top. For further details on this and other interesting types of large forgings, read the article, "Heavy Commercial Forgings," by G. T. Jones, on pages 629–633 of this issue.)

VOLUME 72
No. 8

MECHANICAL ENGINEERING

AUGUST
1950

GEORGE A. STETSON, *Editor*

Greek and Mathematics

FROM time to time attention has been directed in this space to questions relating to the improvement of the quality of the presentation of papers at meetings and of manuscripts offered for publication. It is perhaps a vain hope that mention of these matters may have any marked effect on such improvement. Memories are short and details are annoying. Seldom does instruction coincide with the opportunity to put it into effect before it has been forgotten. Nevertheless there is always the possibility that some authors may read and some remember, and if even a few can be brought to understand some of the reasons why their proofs are not exactly as they think they should be, a small gain at least will have been made.

The American Society of Mechanical Engineers has available for the use of authors a pamphlet "An ASME Paper" in which will be found a quantity of detailed instructions and advice about preparing manuscripts and presenting papers. If it were known that an author were about to write a paper, it would be a simple and helpful practice to send him a copy of this pamphlet. Indeed, this is done. But many papers are written before the program-making groups know the intention of the author and hence the pamphlet reaches him too late. In other cases he neglects to use it. However, frequent printing of instructions on the back cover page of the *Journal of Applied Mechanics* has borne fruit and justifies further attempts to reach authors of future technical papers.

When a manuscript is sent to the printer to be put in type it bears an amazing number of instructions, particularly if the text consists of anything more than straightforward sentences in English. Wherever mathematics is used or special characters appear, explicit instructions to the printer are necessary. For example: All Greek letters are marked for identification. Since authors, typists, and compositors are seldom Greeks and typewriters seldom contain Greek letters, which makes it necessary to put such characters into the manuscript by means of pen or pencil, careful marking of each Greek letter is desirable. Alphas become confused with lower-case English a's, rhos with p's, and so on. An experienced style editor can usually figure out what is desired and so marks the manuscript, but some of the characters are so strangely formed that no one can be sure what was intended. If an author must use Greek letters, he should mark each one "Greek alpha" or "Greek rho," for example.

Nor are English letters beyond being mistaken. Lower-case c's are readily confused with capital letters. The numeral 1 and the letter l are made with the same character on most typewriters. Zeros and capital O's are the same on a typewriter but are different characters in printer's type. Much mathematics has to be hand-lettered in whole or in part in a manuscript. Carelessness leads to confusion in respect to subscripts and superscripts. Minus signs and dashes are not easy to distinguish. The author knows what he wants, but will the printer?

There is only one safe rule to avoid confusion: Mark everything of an unusual nature, even if it looks silly to do so. It will save the Society money and the author annoyance.

Quotations

AMONG the hazards that education, particularly at the college level, faces continuously are two which are too frequently ignored. One is the danger that a narrow concept and pattern of a college training may predominate because the vocational objective overshadows the broad educational objective. The other is the failure to realize that an educational process involves pupil as well as teacher; the teacher to instruct and inspire, the pupil to receive, to digest, and to put to use as a member of society the knowledge and methods of increasing knowledge from which he himself has benefited.

Some remarks relating to the foregoing aspects of education were recently made by L. K. Sillcox, honorary member ASME, to the Mechanical Engineering Advisory Council of Princeton University. Said Dr. Sillcox in the course of his remarks:

"Those equal to a position of leadership must not only be educated but, what is more, they must be given the freedom and capacity to educate themselves. Suitable education is necessary, but in it the part played by the teacher is much greater than the part that the pupil must take at his own risk and his own initiative. It goes without saying that the education given must be in the fullest sense liberal and humane, not partisan or sectarian, for sects and parties are only a healthy growth when grafted on the stock of the common humanities. Anything else would not be education worthy of the name, but a conditioning for alien purposes and a degradation. At any rate (once the schooltime proper is outgrown) men cannot be kept under tutelage with the belief or pretext that their education is being continued, since in this way they will evidently never become edu-

cated at all. And, as we would avoid futile overdiscipline by permitting boys to learn from the experience of their own mistakes, so must we believe also in the men whom we want to train as citizens to play a part in the engineering life of their country. These two stages of education, by the teacher and by life, serve not only to provide constantly new recruits for the engineering class; they also provide the environment in which new ideas, bold designs, skillful measures, and wise provisions, born and matured in the minds and hearts of a few, may be received with less misunderstanding and opposition, and may find many minds ready to support them and to co-operate in their realization.

"In any industrial organization men are more necessary than money or machines; therefore, the engineering school works upon the most important element in commercial success. In many ways the job to be done is like a manufacturing process. The school secures its raw material from the preparatory schools in the form of young men with crude ideas of practical life, with little conception of the purpose of a technical education, and with a fair preparation in several lines of study. During four or five years it endeavors by means of separate and assembling processes to produce men who can 'do things.' Thus the finished product of the technical school forms a most important part of the raw material of manufacture, science, construction, operation, and commerce. The difficulties encountered in technical education are not met in the delivery of certain courses. They result from the attempt so to co-ordinate these courses as to develop accuracy, quickness of perception, imagination, common sense, and individual qualities. Leading engineers who are employers of technical graduates place greater value upon the priceless personal qualities of the young men than upon their ability to produce designs and deal in formulas. They expect the schools to turn out men of character as well as attainments.

"Not a little of the success of a school depends upon the quality of men who enter and upon the requirement of severe and continuous application. The results of training depend very largely upon the personality of the student before he enters the institution. They are affected also by influences not directly resulting from study; for example, athletics and social activities. The direct mental effect of the studies is, therefore, not the only result and possibly not the most important result of the training."

Pondering on these quotations and their significance, one is impressed with the value to the engineering profession, to industry, and to the nation of the program of activities which the Engineers' Council for Professional Development has undertaken. In its work with student selection and guidance it finds itself in a position to discover and encourage those youths who have not only the mental but the personality qualifications to make them suitable recruits in engineering. In its work with the engineering schools it can exert powerful influences in setting up and maintaining standards of quality and performance in the field of formal engineering education. And in its work with young engineers in training for careers in the practice of engineering it can assist in the development of men of technical ability and broad interest in humane and civic matters who are essential to the welfare of modern society. It is generally admitted today that breadth and depth of education are essential to successful practice of engineering in its fullest measure of service to mankind. The processes of education, initiated by the teacher and later supplemented by life itself, are also now considered to be two phases of a continuous process, which, beginning in youth, continue to the end of life itself with men who are the greatest credit to the profession and who serve their fellows most abundantly. Through ECPD, engineers have developed a means by which this continuous process finds encouragement and nourishment.

Power Show Attracts Engineers

THE National Exposition of Power and Mechanical Engineering, more popularly known as the Power Show, will hold its nineteenth session in New York during the week of Nov. 27, 1950, running concurrently with the 1950 Annual Meeting of The American Society of Mechanical Engineers. Co-operation of ASME with the management of the Power Show should serve to stimulate interest and attendance and to draw closer together these two significant events.

The Power Show originated as a separate exposition in December, 1922. Prior to that date what is now known as the Power Show was the annual Fuel Economy Section of the Exposition of Chemical Industries. Through 1930, expositions were held annually. Since 1930, they have been held every other year and have been devoted to exhibits of mechanical engineering for the production, control, distribution, and use of power. Equipment and instruments have been widely shown. Displays of equipment for special purposes in the application of power, such as that used in materials handling and packaging, and certain types of machine tools were later added.

At the 1948 Power Show there were 374 exhibits and the registered attendance (the Show is not open to unrestricted public attendance) was 43,467. A breakdown of the registration showed visitors from 1495 cities and towns in 47 states, and 128 cities in 34 foreign countries. Who visited this exposition? There were more than 14,000 executives, more than 12,000 technical personnel, about 11,000 persons engaged in operation, and 4000 in construction. Dozens of industrial groups were represented by these visitors, the largest groups (registration in excess of 1000 each) being building and construction; chemical equipment, plant design, and construction; electrical dealers, wholesalers, installation, and manufacturers; consulting engineers; food and beverages; government departments; graphic arts; importers and exporters; instruments; iron and steel; mechanical handling and power transmission; power-plant equipment; and public utilities. The field of education was strongly represented by 1700 students and nearly 500 professors and instructors.

MOTORS *for* INTEGRAL MECHANISMS

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INTRODUCTION

UNTIL comparatively recent years, it has been considered below the dignity of a qualified engineer to devote his time and skill to small mass-produced motor-driven machines. Careful analysis, ingenious design, and patient tests were the exception; a quick mock-up, a hasty test, and patched-up changes, the rule. This was on the theory, in many cases, that the product was expendable and the market transient. However, as the demand has matured and stabilized, the business in such machines has grown to startling unit and dollar totals (Tables 1 and 2), even challenging the capital-goods industries. More important for our present purpose, good engineering design has changed from a luxury to a necessity. This is further pointed up by the fact that most of these machines are now in applications important to the customer, with considerable convenience, monetary risk, or even safety, depending on their correct operation. Consider, for instance, a hospital oxygen-tent pump, a railway-track switch, or the compressor for a frozen-food locker plant. Even frequent repetition cannot overemphasize the axiom that satisfactory field performance depends critically upon good design, materials, and workmanship. This salient truth is feelingly supported by every manufacturer who has gone through the headaches, losses, and temporary customer disgust in reaching a good field reputation. Most projects, including present successes, have gone through periods of serious questioning on the advisability of continuance.

When an engineer first faces the problem of designing his machine, he usually can choose between conventional motor drive and "built-in" motor drive. The following are the determining factors in the choice:

Conventional motor	Integral motor
Motor and starting accessories guaranteed by motor vendor.	Lowest cost when all tooled.
Motor service replacement simple.	More compact.
Quantity may be in medium or low production.	Fewer parts.
May mount load element on motor shaft if uncomplicated.	Fewer bearings.
Benefits by large production of general-purpose types.	Simpler mountings.
	Safer.
	But, requires knowledge of good motor practice.

Many motor manufacturers prefer conventional motor applications because in that way they have more control over the variables. However, it is the thesis of this paper that, where justified, the integral-motor design yields the best performance and the lowest cost. It is therefore necessary to publish for designing engineers the greatest amount of usable motor information for the ultimate end of reducing the time, experimentation, and cost required to arrive at a sound design.

Contributed by the Machine Design Division and presented at the Semi-Annual Meeting, St. Louis, Mo., June 19–23, 1950, of The American Society of Mechanical Engineers.

TABLE 1 1948 U. S. PRODUCTION OF MOTOR-OPERATED MACHINES

Domestic	Units	Retail value, millions
Refrigerators	4500000	$1,178
Home freezers	680000	203
Standard washing machines	4300000	722
Small washing machines	310000	10
Dishwashers	230000	62
Ironers	470000	65
Clothes driers	75000	18
Floor vacuum cleaners	3500000	268
Hand vacuum cleaners	300000	8
Room air conditioners	90000	41
Garbage disposers	175000	19
Desk fans	2900000	50
Attic fans	85000	11
Circulating fans	180000	16
Food mixers	1800000	70
Water pumps	650000	89
Air furnaces	400000	92
Oil burners	460000	50
Stokers	76000	26
Total	21186000	$2,998

TABLE 2

Commercial-Industrial		
Commercial Refrigeration		
Hermetic	520000	45
Belt drive	200000	30
Floor machines	26000	2
Gear motors	24000	5
Gasoline vending pumps	190000	9
Industrial fans and blowers	600000	30
Stokers	10000	1
Oil burners	27000	2
Machine-tool motors	120000	28
Portable tools	1000000	50
	2717000	$ 202

It is our present purpose to set forth the basic properties of motors as applied to built-in mechanisms. A further paper is planned which will study motor mechanical considerations, applied to the same kind of mechanisms.

To limit the field, we shall define the integral-motor mechanism in the following terms:

Single function	Mass production
Self-contained	Fractional or low-integral-horsepower motor
High duty factor	Motor structure provided by driven mechanism

Figs. 1, 2, and 3, showing domestic refrigerating-machine compressors, are good examples of the type of mechanism to be studied. Other illustrations will follow later. In any selected case, minor variations of the foregoing characteristics may appear, but the major features should correspond. Practically all of the subject machines will be below 5 hp or even 3 hp; because in larger sizes the motor weight and size so dominate the design, and production is generally so limited that "building-in" is practically never economical.

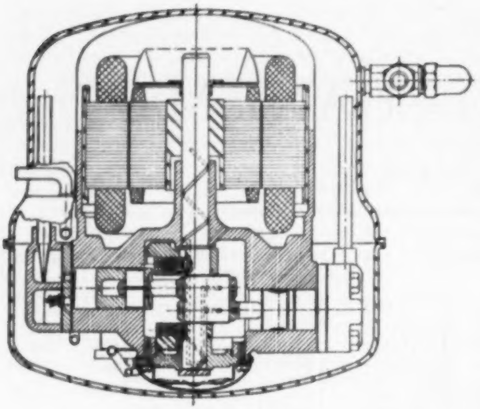

FIG. 1 COMPRESSOR FOR DOMESTIC REFRIGERATOR (Tecumseh.)

5 Industry standard motor components used (with limited exceptions).

These assumptions are selected to limit the discussion to those products which are carefully designed, redesigned, tested, (both in laboratory and field), tooled, and finally produced with the expectation of contributing to the art and staying in the business.

Mechanisms will be classified according to method of cooling because that characteristic is probably the most influential in basic design. Usually the motor is the greatest source of heat, since it is the first element in the line of power transformations, and since its efficiency is ordinarily no greater than that of subsequent components.

Three classes are listed as follows, together with a few illustrations of representative devices:

(*a*) Convection-cooled: Heat lost to air circulated by rotor fan. Food mixer, gear reducer, vacuum cleaner.

(*b*) Conduction-cooled: Heat loss shared by circulating air and pumped fluid or metallically conducted to adjacent dissipator. Garbage disposer, pump, blower.

(*c*) Liquid-cooled: Core and windings in heat-dissipating contact with lubricant. Refrigerator, transformer oil circulator, automatic washer.

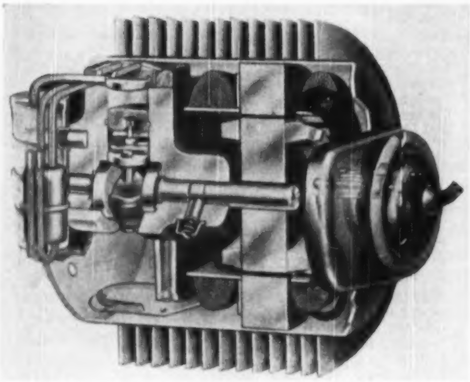

FIG. 2 COMPRESSOR FOR DOMESTIC REFRIGERATOR (General Electric.)

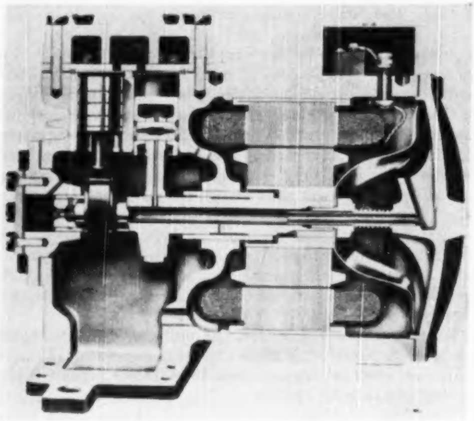

FIG. 3 COMPRESSOR FOR DOMESTIC REFRIGERATOR (Copeland.)

The lower power limit is assumed to be $^1/_{10}$ hp, because below this value the motor is generally not for power-conversion purposes, but for timing or torque; and efficiency is not important. In these latter cases design merit is judged on cost, size, simplicity, or some combination rather than performance primarily.

Parenthetically, it can now be noted that the proposed field thus covers the whole range of mass-produced integral motor mechanisms.

MECHANISM TYPES

The following assumptions are made, since high quality, "engineered," mechanisms are under discussion:

1 Substantially no wear (rated life is in 1000's or 10,000's hr).

2 Practically no failures (high safety factor).

3 Lifetime lubrication.

4 Lowest ultimate cost (quantity high enough for adequate tooling).

Figs. 4, 5, and 6 show examples of the three classes in order and demonstrate the general advantages of all classes: (*a*) more compact, (*b*) fewer parts, (*c*) fewer bearings, (*d*) simpler mounting, (*e*) safer.

The fully sealed or hermetic mechanism (Class *c*, Figs. 1, 2, 3, 6) has further advantages over those just listed. This type approaches the ultimate in reaching good engineering objectives.

Where justified, this design is:

1 Quietest
2 Safest
3 Most tamperproof
4 Most rugged
5 Smallest (with a given type of motor)
6 Best lubricated
7 Best protected from environment

In addition, such a mechanism can benefit by internal hydraulically operated auxiliaries, where needed

CLASSES OF AVAILABLE MOTORS

The preferred available motors are drawn side by side in Fig. 7 to show physical arrangements and to correlate the differences. Four other major types are made, but they are not in as wide use and hence are not included. These excluded motors are (*a*) rotating field, stationary armature, (*b*) axial air gap, (*c*) repulsion start-induction run, and (*d*) shunt-repulsion. The series motor can be run on either alternating or direct current, but other d-c motors will not be discussed. The main views in Fig. 7 show portions of typical windings and sectors of rotor and stator laminations to scale. These windings have been taken from motors in production in the middle of the horsepower-rating range listed for the class. In the induction motors (A, B, C, and G) the start windings are the inner-coil groups and the run windings are outer-coil groups. Below is a wiring diagram using standardized lead numbering. At the bottom of each motor section is a quantitative vector diagram of the

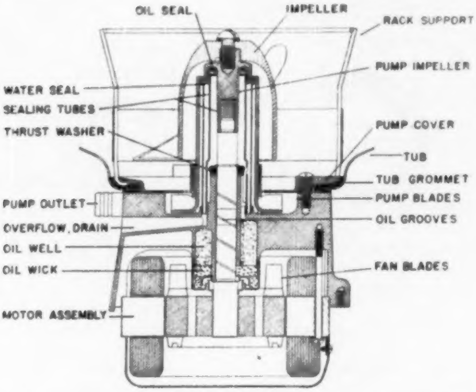

FIG. 4 MOTOR, PUMP, AND IMPELLER ASSEMBLY FOR DISHWASHER

starting condition showing currents and phase angles to scale. The vector diagrams of the running condition have not been included because they are all the same except for phase angle, as will be shown later in Table 3.

In brief summary, these motors are:

A Split-phase: Induction motor with high-resistance start winding. Centrifugal switch cuts start winding out of circuit at 60–80 per cent full speed.

B Capacitor start: Induction motor with low-resistance start winding and high value (approximately 150 mfd) electrolytic capacitor in series. Very high starting torque. Centrifugal switch operates as in A.

C Two-value capacitor: Induction motor with slightly better power factor and higher efficiency than B, but starts the same way.

D Repulsion-induction: Induction motor having a wound rotor overlying a squirrel cage which is deep in the slots. Two short-circuited brushes (per pair of poles) are in contact with the commutator during start. The wound rotor starts in a manner similar to a series motor, except that the rotor current is induced instead of direct-connected. The squirrel cage is not active during low speeds due to flux leakage between rotor teeth. The brushes stay in contact all the time, and the squirrel cage acts as a motor below synchronous speed and as a brake over synchronous speed. The second effect keeps the no-load speed down to only about 125 per cent of the synchronous value.

E Polyphase: Typical 2- or 3-phase motor. (3-phase in case shown.) High inherent starting torque. No start windings, as such.

F Shaded pole: Induction motor with starting torque provided by delaying the flux at one edge of the pole tip. This phase change corresponds to the extra magnetic field provided

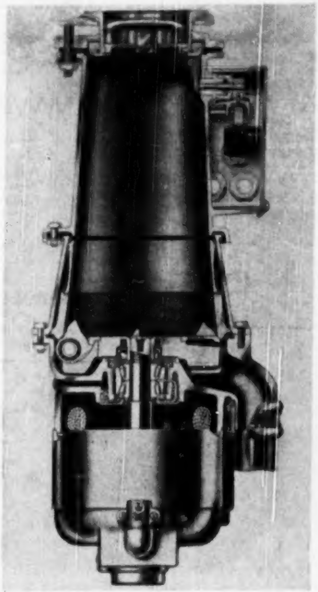

FIG. 5 MOTOR, GRINDING HEAD, AND HOPPER ASSEMBLY FOR GARBAGE-DISPOSAL UNIT

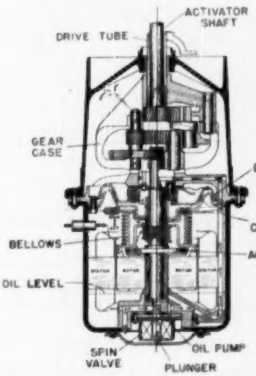

FIG. 6 MOTOR, CLUTCH, AND GEARING ASSEMBLY FOR AUTOMATIC WASHER

by the conventional start winding and results in a unidirectional starting torque. The delay is caused by the small solid copper shading coil around each clockwise pole tip. The "shaded" flux is delayed because it is proportional to di/dt,

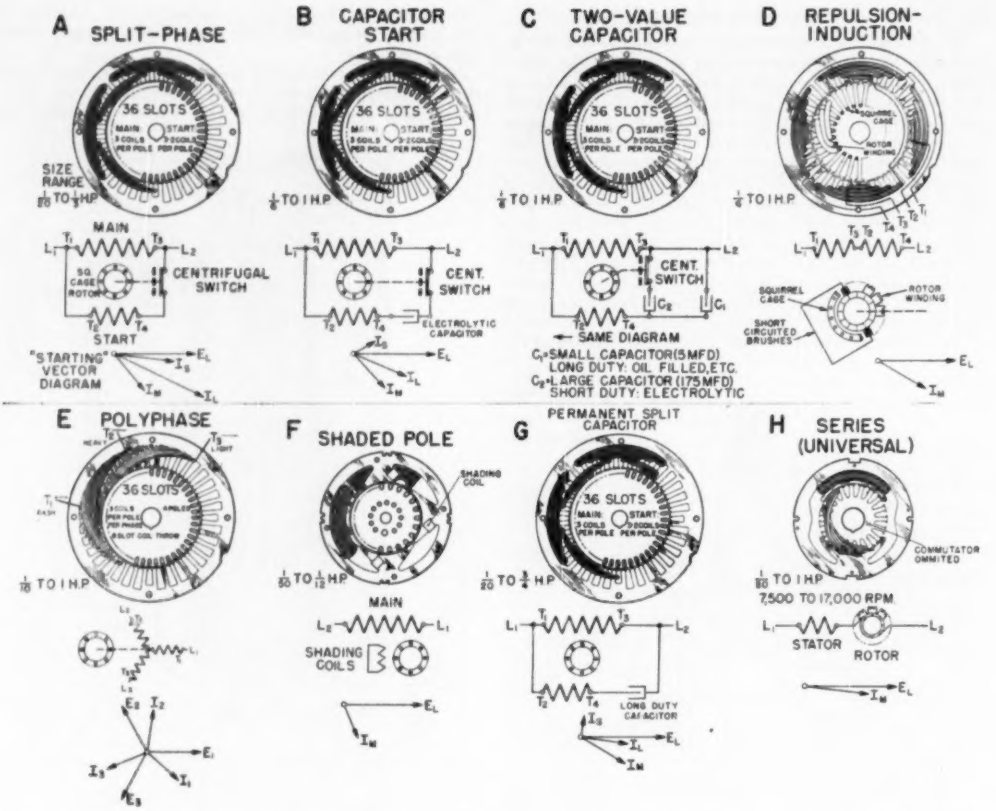

FIG. 7 COMPARISON CHART OF CONVENTIONAL AVAILABLE MOTORS, SHOWING WINDING ARRANGEMENTS, LAMINATION SHAPES, WIRING DIAGRAMS, AND STARTING VECTOR DIAGRAMS

and hence is about 90 deg retarded. This motor has low starting torque, but it is low in cost and it is good for fan-type loads.

G Permanent split capacitor: Induction motor with start winding permanently connected through a long-life series capacitor (approximately 5 mfd) to the line. No starting mechanism.

H Series (universal): The field coils and wound rotor (through commutator and brushes) are in series. Torque results from reaction of two independent magnetic fields, having a constant angular relation determined by brush location. Operation on alternating current changes the performance only slightly from that on direct current. Not satisfactory for operation in a sealed mechanism due to commutator.

The starting accessories will be discussed in detail later in the paper. The motor class names are those accepted as standards by NEMA (1)[1] in its publication MG1, Sections 1.7, 1.8, 1.9, and 1.10.

Within any given class, the motor designer has certain latitudes, aside from size. First he chooses the number of poles, leaning toward fewer poles when choice is possible. Then comes frame size. NEMA has standardized on both outside and rotor bore diameters (see section on "Motor Standardization"); but usually a given horsepower can be put in at least two frame diameters, using long and short stacks. Especially at this point the motor customer can influence the design to his best advantage. Following these come the other usual parameters:

(a) Number of slots (2 or 3 standard arrangements per frame size).
(b) Stack height.
(c) Coils per pole, and per phase.
(d) Turns per coil.
(e) Wire size.

Of this list, the variables most easily handled (and changed) are stack height, coil turns, and wire size. The more recent references on motor design are listed in the Bibliography.

Specific winding methods are best adapted to each of the foregoing motor classes. Machine winding is done on a stator core, basically, by paying out the wire into the slots and around the end turns through a hollow-nosed finger, mechanically traversing the given loop for the required number of turns.

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

TABLE 3 TYPICAL PROPERTIES OF ALTERNATING-CURRENT MOTORS

Class	Rating, hp	Typical full-load speed, rpm	Efficiency, per cent: Full load	Efficiency, per cent: Maximum	Power factor, per cent: Full load	Power factor, per cent: Maximum	$\frac{T_{max}}{T_n}$	$\frac{T_{stg}}{T_n}$	$\frac{I_{stg}}{I_n}$	Reversibility
Resistance split-phase induction	1/20	4p—1725	40	45	54	75	2.6	2.4	6.2	Not instantaneously reversible
	1/6	4p—1725	64	65	66	83	2.5	2.0	7.15	
	1/3[a]	4p—1725	62	62	63	84	2.8	2.2	8.0	
	1/3	2p—3450	75	76	72	89	2.9	2.0	7.5	
	1/4	6p—1140	57	59	59	77	2.2	1.8	6.0	
Capacitor start-induction run	1/6	4p—1725	62	64	64	87	2.9	4.9	5.75	Not instantaneously reversible
	1/3	4p—1725	73	74	74	84	2.6	4.5	5.0	
	1	2p—3450	73	73	73	86	2.5	2.4	4.7	
	1/2	6p—1140	71	72	57	74	2.5	3.3	4.75	
Permanent split capacitor	1/6	4p—1620	65	65	85	90	2.4	.55	3.5	Instantaneously reversible
Shaded-pole induction	1/20	4p—1550	29	29	62	62	1.35	.35	1.5	Not reversible
	1/12	6p—1050	30	30	58	58	1.30	.37	1.5	
Repulsion induction	1/6	4p—1725	58	61	61	76	2.4	4.7	2.5	Not instantaneously reversible
	1/2	4p—1725	61	65	55	73	2.8	4.7	2.75	
	1/3	2p—3450	55	56	88	92	2.3	3.8	4.25	
Polyphase induction	1/6	4p—1725	70	74	72	92	4.5	3.8	6.85	Instantaneously reversible
	1/3	4p—1725	78	78	78	91	3.9	3.3	7.3	
	1/2	4p—1725	75	75	75	91	4.3	3.0	7.45	
	1/3	2p—3450	75	76	81	92	4.1	3.4	7.4	
	1/6	6p—1140	68	72	56	86	4.3	3.6	5.0	
Series	1/80 to 2	2p—5000 to 17500	25 to 80		85 to 95		T_{max} occurs at starting	T_n depends on ventilation	Depends on rated condition	Usually not reversible

[a] Short hour duty rating.

A shift is made in the machine cams to change the traversed loop to a different pair of slots. Wire is continuous from one coil to another. Of course, a fixed wire tension is maintained during winding to obtain best slot packing and to minimize stretching which increases the electrical resistance due to work-hardening. For distributed windings, the machine can wind only one coil at a time. However, for salient poles (classes F and H), all the poles can be wound at once with several "guns" operating simultaneously. Also the winding speed is much faster because the wire doesn't have to be guided through a narrow slot, both of these factors permitting considerable savings on salient-pole motors.

Simple hand-placing of prewound loose coils is still largely used and in many places, competitively. Here the maximum practical number of coils (usually 3, 4, or 5) are picked up manually as one continuous wire and fed, conductor by conductor, progressively into the proper slots. The end turns are formed back to shape for rotor clearance, and the coils corded or served into place.

On some salient-pole motors prefinished coils (usually taped and/or varnished) are slipped on and clamped. This is the simplest and cheapest winding method. The similarity of methods is shown by the identity of the stators of the first three motors (A, B, C) in Fig. 7.

Two of these winding methods are illustrated in Fig. 8 which shows a developed winding of motor A, Fig. 7. Here the coil and coil-group axes are shown in their actual relative positions. The internal connections are more clearly shown in Fig. 9 for the same motor. The main winding is machine-wound and continuous between like poles (N to N, S to S). The start winding is hand-placed, however, and continuous between adjacent poles (N to S to N to S). This difference in machine winding is due to the twin necessities of winding in one direction only (clockwise shown) and in winding from innermost coil out. Wire junctions are shown as black dots in Fig. 9. For any given motor, it is left to the manufacturing engineer to choose the most economical combination of methods for winding.

Finally, the motor may have any internal combination of series/parallel coil connections. The actual connection is determined by current and wire-size limits. Usually, economy requires connecting as many intraphase coils in series as possible, i.e., main, start, polyphase. In Figs. 8 and 9 all the coils of a given phase are in series, respectively.

Also shown to the left in Fig. 8 is a half-section of the rotor

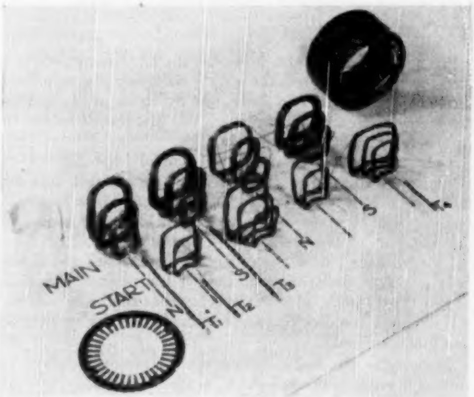

FIG. 8 DEVELOPED WINDING FOR $^1/_3$-HP SPLIT-PHASE MOTOR, SHOWING SECTION THROUGH ALUMINUM SQUIRREL CAGE AT LEFT, AND RELATIVE LOCATIONS OF MAIN AND START WINDINGS, CENTER

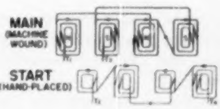

FIG. 9 COIL-CONNECTION DIAGRAM FOR MOTOR IN FIG. 8

squirrel cage, die-cast in aluminum. Note the conductor skew. The shape shown was obtained by selectively acid-dissolving away the iron from a finished rotor assembly.

MOTOR PROPERTIES AND CHARACTERISTICS

This section will describe and explain the detail performance characteristics of the motors illustrated previously.

Induction Motor. The following brief analysis will be directed toward explaining the shape of the torque-speed curve and hence the necessity for start windings on single-phase induction motors (classes A, B, C, D, F, and G). Most of the variations in property of the various types of motors arise from the differences in the starting windings and starting methods.

Engineers generally are familiar with the fact that a polyphase motor develops rotor torque because the stator produces a synchronous, constant-valued, rotating magnetic field which induces current in the rotor bars and reacts with that current to provide the driving torque ($T = K\phi I$). In the polyphase induction motor this becomes

$$T = K_1E^2 \frac{SR_2}{R_2^2 + S^2X_2^2} \text{ oz-ft} \quad \ldots\ldots\ldots\ldots [1]$$

where

E = applied voltage to rotor, per phase
S = per unit slip
R_2 = rotor resistance, referred to stator, per phase
X_2 = rotor reactance, referred to stator, per phase
K_1 = constant

In a single-phase motor, however, the alternating current in the stator winding produces only a pulsating magnetic field. This field is stationary in space, and by virtue of the arrangement of windings, is about sinusoidally distributed around the periphery, one sine loop per pole.

The most widely used theory—"revolving-field" (2) or symmetrical components (3)—is based on the fact that this pulsating field can be resolved mathematically into two equal and opposite constant-valued rotating fields, one forward and one reverse. It is shown in any of the appended references (5, for instance), how the effects of the forward and reverse fields add to produce the net output. The subsequent exposition of this theory is included in the belief that engineers will have a better idea of motor operation from the physical picture and analysis presented.

Electrically, the equivalent circuit of a motor is always considered in terms of equivalent resistance and reactance, as if each power component (stator, rotor, and load) were directly in series across the line. Conversions to this condition are made by the use of turns ratio, as in a transformer, although the exact details are beyond the scope of this discussion. A simple equivalent circuit for the run winding and rotor only is shown in Fig. 10 where the symbols represent

Stator = resistance and reactance of main winding (I^2R equivalent of all main-winding copper and iron losses; and reactance due to leakage flux or self-inductance)
Magnetizing reactance = reactance due to air-gap flux, or mutual inductance)
Rotor = resistance and reactance of rotor conductors (same terms as stator in foregoing); referred to stator
Load = rotor additional resistance, equivalent to mechanical output (I^2R)
S = per unit slip (i.e., at standstill slip is 1.0)
R_2^+ = equivalent series resistance of load referred to stator, forward field
R_2^- = equivalent series resistance of load referred to stator, backward field
I = main winding current

In the Bibliography are further descriptions of this equivalent circuit and the method of converting the rotor parallel circuits to equivalent series circuits. After converting the parallel circuit to the series circuit, the final simplified expression for rotor output is

$$\text{Mechanical output} = I^2\left(\frac{R_2^+ - R_2^-}{2}\right)(1\text{-}S) \text{ watts} \ldots [2]$$

or

$$\text{Torque} = \frac{\text{output}}{\text{speed}} = 113\ \frac{I^2}{N}\left(\frac{R_2^+ - R_2^-}{2}\right) \text{oz-ft} \ldots [3]$$

where N = synchronous speed; I = line current.

The four functions I, R_2^+, R_2^-, and $(R_2^+ - R_2^-)$ have been plotted versus slip for a typical $^1/_4$-hp motor in Fig. 11, and multiplied appropriately together to show the resulting torque curve. This has been extended in the reverse direction to show the polar symmetry of torque for the run winding operating alone in either direction. It can be noted that the run winding has no torque at standstill, or even appreciable torque up to

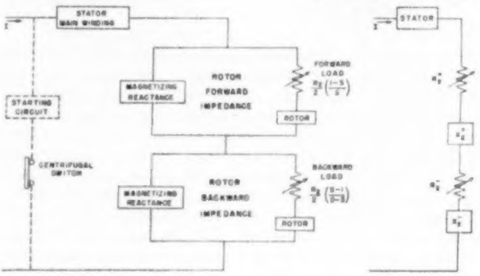

FIG. 10 EQUIVALENT CIRCUITS FOR SINGLE-PHASE INDUCTION MOTOR WITH SERIES CIRCUIT AT RIGHT DERIVED FROM PARALLEL CIRCUIT AT LEFT

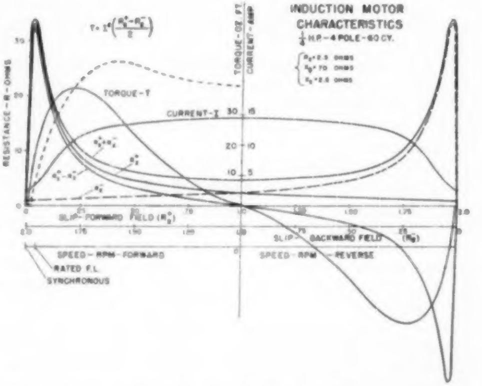

FIG. 11 ANALYTICAL CHARACTERISTICS OF RUN WINDING OF SINGLE-PHASE INDUCTION MOTOR BASED ON "REVOLVING-FIELD" THEORY

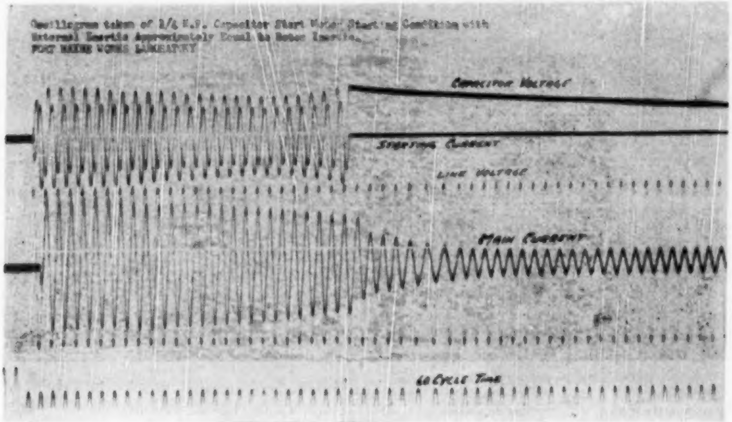

FIG. 12 OSCILLOGRAM OF STARTING CONDITIONS
($^1/_4$-hp motor using centrifugal switch.)

$^1/_4$ speed in either direction. The symmetry is explained in part by the fact that R_2^+ and R_2^- are mirror images on the chart.

Start Winding. When a second pulsating magnetic field is added to the foregoing, displaced both in time phase and physically 90 electrical deg in space, the resultant is a single rotating field, as with a polyphase motor. This changes the single-phase motor to a polyphase motor, with the resulting high starting torque. This second field is always supplied to start single-phase induction motors (except repulsion-start types). The phase shift of this auxiliary field is obtained either by higher-than-normal resistance in the start winding, series capacitance in the start winding, or by a shading coil on the pole face. Lower-than-normal resistance cannot provide enough phase change. This shading coil is a very low-resistance short-circuited turn around a portion of the pole flux, resulting in a time delay or phase shift of the encircled flux (see motor F, Fig. 7). This is equivalent to the second-phase field. In all induction motors but the shaded-pole types, the equivalent circuit in Fig. 10 is thus changed by the addition of the dotted starting circuit. The torque curve is modified to the dotted line shown in Fig. 11. As later described in more detail, the starting winding is usually disconnected when the motor is up to about 75 per cent of full speed. This is usually done by a centrifugal switch, the device shown in Figs. 7 and 20. Of course, motor reversal is accomplished by simply reversing the start-winding connections with respect to the main. With ordinary low-inertia loads the motor gets up to speed in less than 1 sec, so the starting winding has very short duty. In consequence, the current densities may be designed very high (50,000 amps per sq in) and the wire becomes both small (economical) and high resistance as desired; but it then is vulnerable to burn out. The usual general-purpose motor of this type has a 3-sec rated starting period; much longer periods cause the wire to overheat the insulation. As alternatives, where indicated, start windings may be made of bronze wire for higher resistance, and fiberglas-varnish insulation for greater heat resistance in place of the usual synthetic enamel. For longer starting periods (high inertia loads) a starting capacitor is necessary both for increased torque and for lower start-winding and line currents.

Both the mechanical and electrical performance of a motor can be determined by taking a starting oscillogram of currents (line, main, start) and voltages (line, winding, and starting switch). Also shaft turns, relay operation, etc., can be put on the same film. From phase angle, the instantaneous power and power factors can be readily computed, if desired, from the oscillogram. Acceleration, torque, turns to full speed, etc., can be read or computed from the "turns" trace.

Fig. 12 is the starting oscillogram of a capacitor-start motor (class B, Fig. 7). Note that the start winding was energized for only 25 cycles (less than $^1/_2$ sec); and as seen by the main current, only an additional 12 cycles ($^1/_5$ sec) was necessary to finish coming up to speed. When the switch opens and starting current drops to zero, the capacitor is always left charged; so its voltage gradually drops as the charge neutralizes through leakage.

Whereas Fig. 12 was taken on a motor having a centrifugally operated starting switch, Fig. 13 shows the starting transient for a relay-started motor. The method will be described in detail in the section on Motor Starting. In Fig. 13 the top trace shows the $1^1/_2$-cycle delay necessary for the relay to close and energize the start winding. Otherwise, the two oscillograms are much alike. Incidentally, here the total starting time was only 12 cycles, or $^1/_5$ sec. Fig. 14 shows another starting oscillogram with the addition of a "$^1/_4$-turn" trace at the bottom. Here alternative plateaus and valleys are quadrants around the shaft for a small direct-current pickup brush riding on a sector. This film was taken on a motor started with a "fail safe" reversing relay which will be described in the section on Motor Starting (center circuit, Fig. 24).

The series-motor torque-speed characteristic will be explained only to the following extent: Current I through rotor conductors, linking flux ϕ, causes a driving torque

$$T = K_1\phi I \qquad [4]$$

where K_1 = const.

Also, applied voltage equals the sum of the internally generated back emf in the rotor plus the IR drop of all of the windings. The generated voltage varies with the rate of flux change (or flux value and speed). Hence

$$E_g = V - IR = K_2\phi N \qquad [5]$$

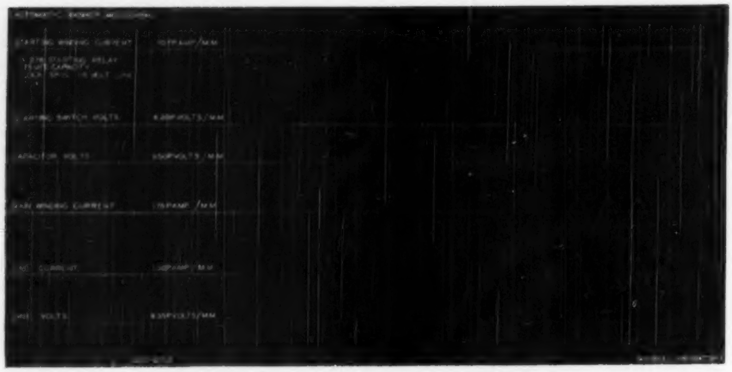

FIG. 13 OSCILLOGRAM OF STARTING CONDITIONS

(Capacitor-start motor with current relay, showing delay in start-winding current after main winding energized.)

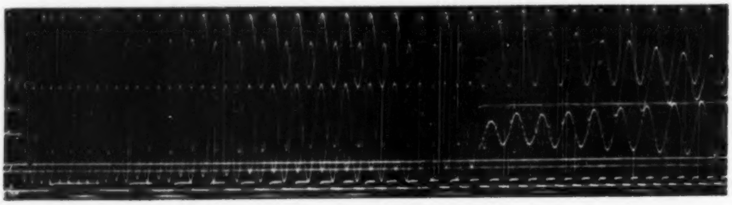

FIG. 14 OSCILLOGRAM OF STARTING CONDITIONS

(Induced-voltage starting relay. Bottom trace F shows $^1/_4$-turn impulses, indicating shaft revolutions.)

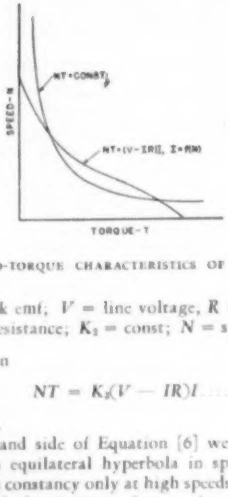

FIG. 15 SPEED-TORQUE CHARACTERISTICS OF SERIES MOTOR

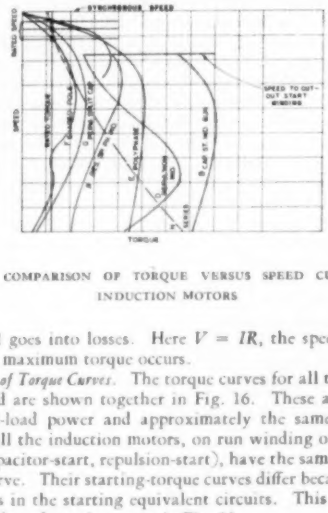

FIG. 16 COMPARISON OF TORQUE VERSUS SPEED CURVES FOR INDUCTION MOTORS

where Eg = back emf; V = line voltage, R = total machine resistance; K_2 = const; N = speed of rotation.

By substitution

$$NT = K_2(V - IR)I \qquad [6]$$

where $I = f(N)$.

If the right-hand side of Equation [6] were constant, the expression is an equilateral hyperbola in speed and torque. (It approximates constancy only at high speeds and is discussed this way here only for purposes of comparison). The variance of I; small at large N and vice versa, modifies such a hyperbola by dropping the level of the inboard portion and raising the outer portion. Fig. 15 shows the theoretical and actual curves. This torque increase persists up to the point where high current saturates the iron, the back emf hence decays and the input power all goes into losses. Here $V = IR$, the speed goes to zero, and maximum torque occurs.

Family of Torque Curves. The torque curves for all the motors mentioned are shown together in Fig. 16. These assume the same full-load power and approximately the same full-load speed. All the induction motors, on run winding only (split-phase, capacitor-start, repulsion-start), have the same running-torque curve. Their starting-torque curves differ because of the differences in the starting equivalent circuits. This correlates with the dotted starting curve in Fig. 11.

The polyphase curve has a characteristic shape of its own due to the difference between Equations [1] and [3].

Some final observations will be made on the curves in Fig. 16: The maximum value of run winding torque occurs at 80 to 85

per cent speed. Both the maximum torque value and speed of occurrence depend critically upon rotor ohmic resistance. As this resistance is increased from its present low value (cast-aluminum squirrel cage), the peak is reduced and the speed of occurrence decreases, causing a drooping curve (less stiff motor). In practice, the rotor-bar cross section is left alone over a whole range of designs, but the end rings (see Fig. 7), are enlarged or reduced in section to reach a desired value.

The shaded-pole motor shows a distinct bump and dip at 1/3 speed. This is due to the third-harmonic parasitic field. The use of salient poles in construction causes a uniform flux density in the air gap under the pole instead of a sinusoidal distribution. By Fourier series, such a nonsinusoidal flux distribution can be resolved into a fundamental and a strong third harmonic. Completely designing out the third harmonic penalizes running performances unacceptably. This third-harmonic flux superimposes on the fundamental torque curve another curve for a motor which has 3 times as many poles, and hence which reaches its synchronous speed at 1/3 normal line frequency. A distributed-winding shaded-pole motor is made having no such torque dips, but its extra cost offsets the economic advantage, so it is seldom used.

Comparative Motor Properties. Table 3 presents a list of motor properties compiled from motors in production. Its purpose is to tabulate for comparison and for reference all the properties of interest to the motor user, and of possible help in original selection of class.

Not enough data are presented to draw curves versus rating, but trends can be noted. For instance, the ratio of maximum torque to full-load torque is surprisingly constant, near 2.5, over the family of single-phase induction motors.

Standards have been established by NEMA covering basic performance characteristics including breakdown torque, starting torque, and starting current. The elective properties are, in general, ratio of starting to full-load torques; efficiency; and power factor.

MOTOR COSTS

The cost per horsepower of the usual motor types is presented in Fig. 17. The bench mark of 100 per cent is taken for the split-phase general-purpose motor (1/4 hp) which, of all types, is the one in largest production. It is observed that minima exist in two curves. This is real and is due to the influence of standard sizes and differing production rates. The costs shown represent full motors, but are reasonably proportionate for built-in parts (i.e., stator and rotor) as well. The costs of motors over 1 hp have been published in a recent periodical (11).

Cost per horsepower as a function of speed is shown in Fig. 18. Here, of course, speed values exist only at the discrete points representing full-load speeds of the several numbers of poles. Again, the 4-pole 1/4-hp split-phase motor is standard for 100 per cent. Both of these figures on cost are taken from production data and reflect production models; stepped and nonuniform size changes by frame size; design and manufacturing refinements put on high-production models; and reduced keenness of competition on less standard lines and models.

Accessory Costs. Starting-accessory costs are shown in Fig. 19. They are discussed at this point in order to complete the cost picture. In two cases, three alternative methods are listed. These are illustrated by diagramming the different components within areas representing the respective approximate proportions of the cost.

The components are listed descriptively in the legend, and, except for the momentary contact switch, are self-explanatory. This latter is a manually operated push-button line switch. The "on" button has a spring-biased further-depressed-position that energizes the start winding in addition to the main winding. Upon release, the on button returns to the first-depressed-position which leaves only the main winding energized. This is illustrated in the section on Motor Starting, Fig. 23.

It will be observed that line-switch costs vary with the motor classes. This is partly due to switch type and partly to the usual sizes of these motors, the higher power motors having more costly switches. Also the capacitor-start and split-phase costs differ only by the capacitor. The cost of "long-life" capacitors is emphasized by the fact that the electrolytic type in these sizes costs less than 1/2 cent per microfarad whereas the long-life type costs more than 25 cents per microfarad.

All these accessories are in high production, so their costs are less influenced by demand than in the case of the motors.

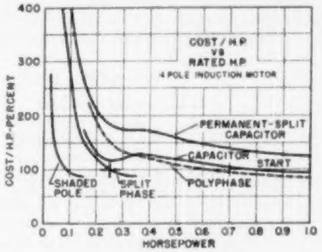

FIG. 17 RELATIVE COSTS OF INDUCTION MOTORS VERSUS RATING

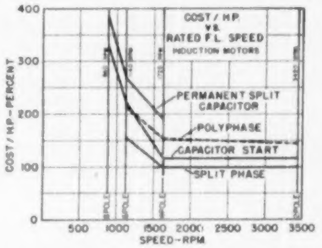

FIG. 18 RELATIVE COSTS OF INDUCTION MOTORS VERSUS SPEED

FIG. 19 RELATIVE COSTS OF INDUCTION-MOTOR STARTING ACCESSORIES

(Proportionate costs of respective components shown by dotted lines.)

MOTOR STANDARDIZATION

As a preface, it is appropriate to note that NEMA standards (1) are created to prevent misunderstanding between manufacturer and purchaser and to aid in selection of apparatus. In no way do these standards prevent the manufacture of "non-conforming" equipment.

Induction Motor-Frame Sizes (NEMA). "Complete" motors are given frame numbers based on the dimension from axis to mounting base. Both fractional and integral-horsepower motors are fully covered in Section 3.1 of MG1, the latest motor-generator standard issued by NEMA. Included in these standards are all types of motor mountings, shaft diameters, tapers, keys, pulleys, and gears, as well as standardized nomenclature for the various dimensions.

"Shell-type" motors consist of "a stator and rotor without shaft, end shields, bearings, or conventional frame. Separate fan or fan larger than the rotor are not included." The "shell" refers to the structural band around the stator laminations. These are listed at present only in integral-horsepower sizes with outside diameters, over the shell, of 8 in., 10 in., 12.375 in., respectively. They are used largely by the machine-tool industry (see MG1-7.216 for complete details).

Hermetic motors consist of "a stator and rotor without shaft, end shields, or bearings for installation in refrigeration condensing units of the hermetically sealed type." Without some of the special degreasing and dehydrating treatments peculiar to refrigeration, such hermetic motors are also used in other applications. Frame dimensions have been standardized for both fractional- and integral-horsepower sizes, including the four classes; split-phase, capacitor-start, two-value capacitor, and polyphase induction motors (MG1-7.15 and MG1-7.228) (Table 4).

Mounting information such as dimensions over windings, counterbores, etc., is given in MG1-7.16 and MG1-7.228. All axial dimensions given are maxima for given horsepower ratings, with the exception that a definite axial shell length is listed for mounting purposes.

TABLE 5 PARTS FOR UNIVERSAL MOTORS

Stator OD, in.	Stack height plus height of one end turn (range due to rating), in.
2.125 (+0.000, −0.002)	$1\frac{7}{16}$ to $2\frac{3}{16}$
2.437	$1\frac{7}{16}$ to $2\frac{3}{16}$
2.875	$1\frac{1}{2}$ to $2\frac{1}{4}$
3.187	$1\frac{1}{2}$ to $2\frac{1}{4}$
3.687	2 to $3\frac{5}{8}$
4.375	$2\frac{5}{16}$ to $3\frac{15}{16}$

Futher dimension standards are created by individual manufacturers. One large manufacturer has a standard air gap of 0.012-in. nominal for all induction motors of the $\frac{1}{20}$ to 1-hp power range. In the same instance, stack heights are in multiples of $\frac{1}{8}$ in. for lengths up to 2 in. and in $\frac{1}{4}$ in. multiples above. The lamination diameters for the foregoing stator diameters are smaller by the thickness of the shells when the core is welded or riveted, using no shell.

Universal (Series) Motor Frame Sizes (NEMA). Universal motors are listed by NEMA, only as sets of parts consisting of rotor, stator, brush, and brush holder. The standardized stator is simply a rigid stack of laminations (welded, riveted, or clipped together) with no shell or frame for structure. The sizes are given in Table 5. Full details of Universal motor standard dimensions are given in MG1-7.1.

TABLE 4 CHARACTERISTICS OF HERMETIC MOTORS

	Stator outside diam., in.	Rating range, hp	Optional rotor bores, in.
F.H.-P.:	5.480 (+0.000−0.002)	$\frac{1}{12}$ to $\frac{1}{6}$	0.500, 0.625, 0.750 (+0.0005−0.000)
	6.292 (+0.000−0.002)	$\frac{1}{12}$ to $\frac{3}{4}$	0.625, 0.750, 0.875 (+0.0005−0.000)
	7.480 (+0.000−0.002)	$\frac{1}{8}$ to 1	0.875, 1.000, 1.125 (+0.0005−0.000)
I.H.-P.:	8.777 (+0.000−0.003)	$1\frac{1}{2}$ to 5	1.125 (+0.0005−0.000)
	10.125 (+0.000−0.003)	5 to $7\frac{1}{2}$	1.187 (+0.0005−0.000)
	12.375 (+0.000−0.003)	$7\frac{1}{2}$ to 10	1.500 (+0.001 −0.000)

TABLE 6 CORRELATION BETWEEN HORSEPOWER RATING AND BREAKDOWN TORQUE

Standard frequency, cycles	60	50	60	50–25	60	50	60
Nominal speed, rpm	3450	2850	1725	1425	1140	950	850
Horsepower	Fractional-horsepower motors; breakdown torque, oz-ft						
$\frac{1}{20}$	2.0– 3.7	2.4– 4.4	4.0– 7.1	4.8– 8.5	6.0–10.4	7.2–12.4	8.0–13.5
$\frac{1}{12}$	3.7– 6.0	4.4– 7.2	7.1–11.5	8.5–13.8	10.4–16.5	12.4–19.8	13.5–21.5
$\frac{1}{8}$	6.0– 8.7	7.2–10.5	11.5–16.5	13.8–19.8	16.5–24.1	19.8–28.9	21.5–31.5
$\frac{1}{6}$	8.7–11.5	10.5–13.8	16.5–21.5	19.8–25.8	24.1–31.5	28.9–37.8	31.5–40.5
$\frac{1}{4}$	11.5–16.5	13.8–19.8	21.5–31.5	25.8–37.8	31.5–44.0	37.8–53.0	40.5–58.0
$\frac{1}{3}$	16.5–21.5	19.8–25.8	31.5–40.5	37.8–48.5	44.0–58.0	53.0–69.5	58.0–77.0
$\frac{1}{2}$	21.5–31.5	25.8–37.8	40.5–58.0	48.5–69.5	58.0–82.5	69.5–99.0	
$\frac{3}{4}$	31.5–44.0	37.8–53.0	58.0–82.5	69.5–99.0			
1	44.0–58.0	53.0–69.5					
	Integral-horsepower motors; breakdown torque lb-ft						
$\frac{3}{4}$					5.16– 6.9		
1			5.16– 6.8	6.19– 8.2	6.9– 9.2		
$1\frac{1}{2}$	3.6– 4.6	4.3– 5.5	6.8–10.1	8.2–12.1	9.2–13.8		
2	4.6– 6.0	5.5– 7.2	10.1–13.0	12.1–15.6	13.8–18.0		
3	6.0– 8.6	7.2–10.2	13.0–19.0	15.6–22.8	18.0–25.8		
5	8.6–13.5	10.2–16.2	19.0–30.0	22.8–36.0	25.8–40.5		
$7\frac{1}{2}$	13.5–20.0	16.2–24.0	30.0–45.0	36.0–54.0	40.5–60.0		
10	20.0–27.0	24.0–32.4	45.0–60.0	54.0–72.0			

Torque and Rating Standards (NEMA). All single-phase induction motors of any rating and all polyphase motors up to 1 hp are power-rated by the value of breakdown torque (maximum torque on the run winding). Until the recent issue of this standard, several bases of rating had been used, including duty, temperature rise, torque safety factor, etc.

For all the motors presently under discussion, Table 6 (from MG1-2.7) presents the correlation between horsepower rating and breakdown torque. At any given frequency, all torques from lowest to highest are included within a range specified for the given standard horsepower rating.

The following are the various meanings given to the "breakdown torque:"

(*a*) Guaranteed (rated) torque: This is the minimum torque of all motors of the purchased lot or shipment.

(*b*) Sigma (σ) torque (statistical): This is the minimum torque which 95 per cent of all the production of a given lot will meet.

(*c*) Nominal torque (approximately 10 per cent higher than guaranteed): This is a design value, of mid-range in manufacturing variations.

(*d*) Maximum torque (approximately 15 per cent higher than guaranteed): This is the maximum value of torque encountered in manufacturing variations. However, values between guaranteed (*a*) and maximum (*d*) are not to be relied upon by the user in application of the motor to its load.

For typical $^1/_3$-hp motors at 1725 rpm, these values are as given in Table 7.

TABLE 7 TORQUE VALUES FOR $^1/_3$-HP 1725-RPM MOTORS, OZ-FT

	Guaranteed	Sigma	Nominal	Maximum
Washing machine.....	33	37	$38^1/_2$	41
General purpose.....	40 5	43 5	45	48

The starting-torque minima have been set for definite-purpose motors because the application is determinative. It is called locked-rotor torque, or slip torque, because it is measured as the minimum torque developed at any angular position of the rotor, and is usually obtained with the rotor slipping very slowly around. Angular variations occur because of tooth line-ups, eccentricities, and metal-grain directions.

Three examples of locked-rotor-torque standards are given; one for general purpose motors, Table 8, one for hermetic motors, Table 9, and one for washing-machine motors, Table 10, representing general-duty, long-duty definite, and short-duty definite ratings, respectively.

TABLE 8 GENERAL-PURPOSE SINGLE-PHASE MOTORS (MG1-4.5)

	Minimum locked-rotor torque, oz-ft					
	60-cycle speed, rpm			50-cycle speed, rpm		
Hp	3450	1725	1140	2850	1425	950
$^1/_8$	..	24	32	..	29	39
$^1/_6$	15	33	43	18	39	51
$^1/_4$	21	46	59	25	55	70
$^1/_3$	26	57	73	31	69	88
$^1/_2$	37	85	100	44	102	120
$^3/_4$	50	119		60	143	..
1	61		..	73	..	..

TABLE 9 HERMETIC MOTORS; 60-CYCLE; 1800 RPM (MG1-7.8)

Rated hp	Breakdown torque, all types, oz-ft	Minimum locked-rotor torque Type I, oz-ft	Type II, oz-ft	Type III, oz-ft
$^1/_{12}$	11.5	7	17	22
$^1/_8$	16.5	9	23	30
$^1/_6$	21.5	10.5	30	39
$^1/_4$	31.5	12	43	56
$^1/_3$	40.5	18	56	72
$^1/_2$	58	40	79	103
$^3/_4$	82.5	60	113	146

NOTE: Values of horsepower are standard ratings.

TABLE 10 WASHING-MACHINE MOTOR (MG1-7.142, -3, -5)

Rating			Minimum
Hp	Cycles	Breakdown torque, oz-ft	locked-rotor torque, oz-ft
$^1/_3$	60 & d-c	33.0	24.0
$^1/_4$	50	37.6	27.5
$^1/_4$	25	36.0	26.1

The differences between breakdown torques for the same horsepower rating reflect the progressive decrease in safety factor between assumed (but unknown) machines, unattended known cycle machines (refrigerator), and attended machines (washing machine). The basic problem is supply. Torque varies as the square of the voltage, and line voltage in many areas drops temporarily below 90 volts. Failure to start or to carry the load will cause misoperation or burnout.

Locked-Rotor Current Limits (*NEMA*). The maximum locked-rotor current on all 60-cycle single-phase motors of any type, except split-phase motors now used on washing and ironing machines, shall not exceed the values given in Table 11.

TABLE 11 MAXIMUM ALLOWABLE LOCKED-ROTOR CURRENT ON 60-CYCLE SINGLE-PHASE MOTORS

	Locked-rotor current	
Rating, hp	115 volts	230 volts
$^1/_6$ and smaller	20 amp	10 amp
$^1/_4$	23	$11^1/_2$
$^1/_3$	31	$15^1/_2$
$^1/_2$	45	$22^1/_2$
$^3/_4$	61	$30^1/_2$

This standard applies to all 60-cycle single-phase motors, 2, 4, 6, and 8 poles.

The washing-machine motors are excluded because their design antedated the standards, and because their higher starting currents generally do not occur at load-peak points of utilities and also not at night when light-blink may be serious. These starting currents are approximately as follow

$^1/_4$ and $^1/_3$ hp—40 amp

although these values are compromises involving the torque to start a gear case with its grease cold, and the low cost of a split-phase motor.

For integral-horsepower and polyphase motors, the locked-rotor currents are given in Table 12.

TABLE 12 MAXIMUM LOCKED-ROTOR CURRENT (MG1-4.8,-.9 FOR INTEGRAL-HORSEPOWER AND POLYPHASE MOTORS

Rating, hp	60-cycle single-phase Design M 115 volts	230 volts	60 cycle three-phase 220 volts Designs B, C, D (see NEMA)
1	70 amp	35 amp	24 amp/hp for 1 hp or less
$1^1/_2$	..	40	35 amp
2	..	50	45
3	..	70	60
5		100	90
$7^1/_2$		150	120
10		200	150

Other Standards. Individual manufacturers develop standards of their own in other features and methods of production. This is especially true of old and large companies. Rather than attempt a coverage of this, it will simply be noted thus, and observe that methods of assembling the core, coiling the windings, serving the windings, bringing out the leads, and manufacturing the rotor squirrel cage are typical subjects for proprietary standards.

MOTOR STARTING AND REVERSING METHODS AND ACCESSORIES

As stated previously, several classes of motors are inherently self-starting; polyphase and series start on their run winding; permanent split and shaded pole have permanently connected start windings. The remaining motors are broadly all single-phase induction motors and are useless without both a starting switch and a control device. There are two reasons for this switching function:

1 Limited thermal capacities and dissipation rates of the start winding in a split-phase motor, and the start capacitor in a capacitor-start motor.

2 Better performance on run winding than when on run and start together. Torque, efficiency, and current definitely better on split-phase motor and usually better on capacitor-start motor.

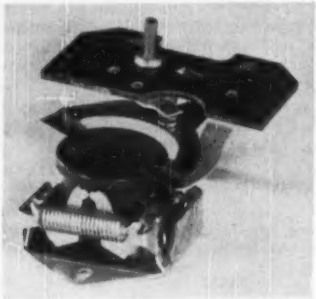

FIG. 20 FRACTIONAL-HORSEPOWER CENTRIFUGAL STARTING MECHANISM AND SWITCH SHOWING ROTATING COLLAR IN CONTACT WITH OPERATING FINGERS AS AT START

(Collar does not touch fingers when rotor is up to speed.)

Depending on the class, motors start with either of two methods: becoming a polyphase motor due to an added appropriate temporary winding, or by becoming a series motor in effect by adding a winding to the rotor, as repulsion motors use. These two problems are dealt with separately in the following:

Single-Phase Induction-Motor Starting. The vulnerability of the start winding of split-phase motors was described in the section on Motor Characteristics. There is also the vulnerable electrolytic capacitor in capacitor-start motors, although in the latter class, the start windings themselves are not as susceptible because of larger wire, lower resistance, and lower currents. Heating is the ultimate cause of failure in both cases, current being the parameter for the split-phase winding. Parenthetically, starting current is nearly constant up to the switching point, as seen in the oscillogram in Fig. 14. For the capacitor, however, voltage is the parameter; and voltage is reasonably constant up to 75 per cent speed where it suddenly increases sharply from 100 volts to 150 volts, for instance. This trend can be observed on the starting-capacitor voltage trace in Figs. 12 and 13. Thus in one case, the starting winding must be disconnected in seconds to save it from overheating, and in the other case the capacitor must be disconnected below a given speed to save it from overvoltage and puncture or short life. The capacitor can tolerate 10 or 20 times the exposure before dangerously overheating, at the rated voltage of 115 volts. This corresponds to an acceleration of a heavy load, as against coming up to speed quickly and remaining on at full load rpm.

(*a*) *Centrifugal mechanism:* For nonsubmerged motors, the usual switch is speed-controlled by a pair of spring-loaded flyweights on the rotor. Fig. 20 shows a modern mechanism and switch, the latter, of course, being a single pair of contacts touching when the rotor is at standstill, and the plastic collar is moved axially to press against the operating switch fingers. Up at speed the collar is retracted and the switch opens due to its normal spring bias. Fig. 12 is an oscillogram of such a start.

Many actual varieties of mechanism exist, but all try to use a toggle type of snap-over at the switching speed to avoid the kissing of the contacts which might occur with slow break action. A trip-speed accuracy of about ±10 per cent of the nominal full-load speed is sought, although the differential may bring the reset speed down to 40 or 50 per cent full load.

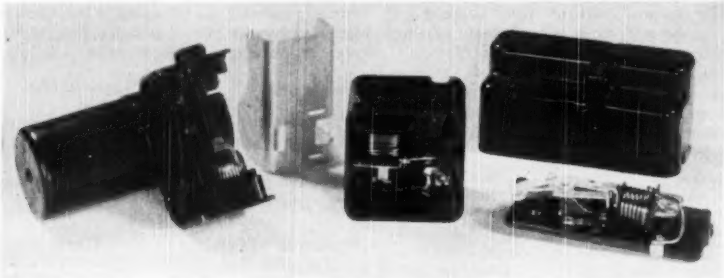

FIG. 21 CURRENT-INRUSH-TYPE RELAYS

(Left and center models vertical coil with gravity return plunger. Left model has integral condenser cavity for mounting remote to motor. Aluminum relay cover standing in rear has windows for observing plunger and contact operation. Relay at right uses swinging armature. Plastic cover is in rear.)

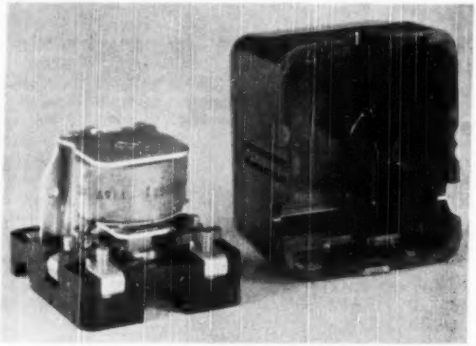

FIG. 22 START-WINDING VOLTAGE RELAY

(Plastic cover at side. Note single contact under coil artificially held in open position for photograph.)

Of course these centrifugal devices are never used in hermetic-motor applications because submerged arcs deteriorate both the lubricant and the contacts.

(*b*) *Current-inrush relays:* Since the main winding current may increase as much as 400 per cent of full load (see Fig. 12), during start, a comfortable region is available to operate a current-sensitive relay. For instance, the minimum (at low line voltage during start) may be 300 per cent, and the maximum running value may be 175 per cent. Hence a band of 125 per cent or several amperes exists in which the main winding current is a safe indication of the need for the start winding. Fig. 21 shows three modifications of this current relay. The left and center units use a plunger, lifting off a switch, and the right unit pulls a spring-loaded armature toward a pole tip. The left unit has an integral cavity for a starting capacitor. In use, the current coil is connected directly in series with the main winding, and the switch contacts are in the start-winding circuit exactly as shown for the centrifugal switches in Fig. 7. Upon closing the line switch, the relay picks up and closes the start winding, holds it in until the main winding current drops a few amperes, and then opens the start circuit again. Fig. 13 is an oscillogram of this operation. Considerable design care in application is necessary in this case in matching the motor-current characteristics to the relay pickup and dropout, and to the expected voltage and load variations. Such current inrush-type relays are presently used on practically all hermetic-motor applications.

(*c*) *Voltage-change or phase-change relays:* Other remote relays depend on the voltage change of the starting capacitor, just mentioned, or, in another instance, on the phase-angle change between start and main windings.

Fig. 22 shows a voltage relay having a normally closed contact and 140-volt dropout with a reset (pickup) at 40 volts. Its operating coil is simply connected across the starting winding, and at the stated voltage, opens the circuit. Once open it remains open by induction, since the main winding generates some voltage in the start winding due to the rotating field. When the motor is turned off, the relay resets, closing the start contacts again. This voltage relay is directly applicable only to capacitor-start motors. If used on split-phase types, an external resistance must be inserted in series with the start winding to obtain the voltage differences. Then the resistance corresponds in function to the foregoing starting capacitor.

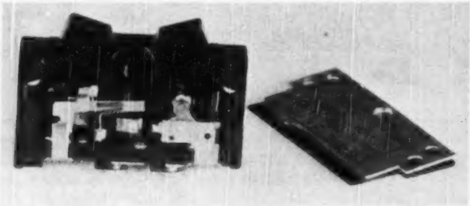

FIG. 23 MOMENTARY CONTACT SWITCH FOR STARTING
(Contacts at right for start winding only. Contact in center for run winding. Note zigzag heater for thermal overload.)

The phase-change relay is not illustrated, but operates on a balanced magnetic circuit with two coils opposing their fluxes. One coil is in series with the main winding and one in series with the start winding. It has been found that near 75 per cent speed, the phase relationship suddenly changes, a net flux results and the relay armature operates, similar in function to those described.

(*d*) *Momentary Switch:* Since the motor in most attended applications accelerates to speed in less than 1 sec, a manually operated starting switch has been developed. The switch is an alternative-push-button type as shown in Fig. 23, and connects both the line and the start winding when pushed "on." When released, only the line remains on. It has been found practically impossible to push and release the switch so quickly that the motor would not get up to speed. In this particular model,

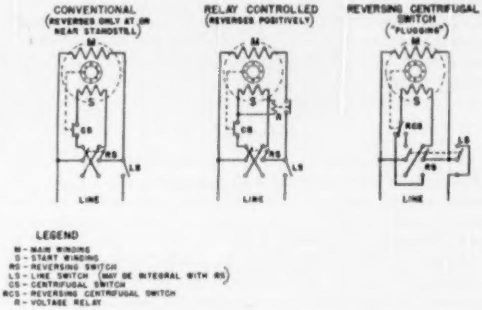

FIG. 24 SINGLE-PHASE INDUCTION-MOTOR REVERSING METHODS
(Reversing centrifugal switch of right-hand diagram same as Fig. 25.)

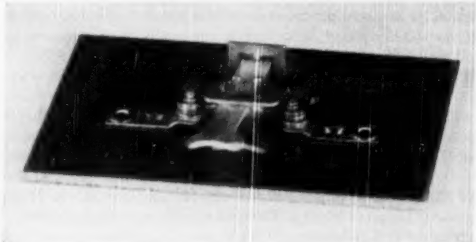

FIG. 25 CENTRIFUGAL REVERSING SWITCH FOR "PLUGGING" SPLIT-PHASE MOTOR
(Operating finger shown by phantom in forward and reverse directions caused by reversal of collar on conventional centrifugal mechanism. In one direction one contact is closed and the other is open and vice versa.)

main-line overload protection is built in to open the line contacts thermally in case of overload.

Repulsion Start Accessories. This subject will be listed only because of relatively infrequent use. Centrifugally operated brush lifters are available for repulsion motors. For repulsion-start induction run motors, commutator-brush lifters and bar shorters convert a wound rotor to a form of squirrel cage by centrifugal action (10).

Reversing Split-Phase or Capacitor-Start Motors. The conventional reversing method is the double-pole double-throw start-winding switch plus a line switch. This is the left-hand diagram in Fig. 24, and requires the motor to slow down to low speed to operate with either the centrifugal mechanism or current relay.

If the motor is to be "plugged" (instantaneously reversed), a proprietary centrifugal switch is available as shown in Fig. 25. The same number of switch blades are required (right-hand diagram, Fig. 24), but full power reversal is possible because of the presence of alternate contacts on the start switch. The

operating finger is shown in two positions in phantom, sliding from one to the other as the motor direction changes. Other switches, both drum and toggle types, are marketed to reverse split-phase motors, but most require the motor to stop before the restart.

Another use of the induced voltage in the start winding to guarantee reversal directions is shown in the middle diagram, Fig. 24, where a relay directly across the start winding operates series contacts in the main winding (18). This method as with the voltage starting relay also uses the induced voltage to hold the relay in after the centrifugal switch cuts out. Reversing then can be done any time by switching, the motor coasting down to the centrifugal reset speed before power is again applied. However, the direction is always predicted (see reference 17, for further reversing circuits).

SUMMARY

Eight general classes of commercially available mass-produced motors have been described and their properties listed. The basic starting methods, characteristics, and auxiliaries have been discussed. References have been made to manufacturing and performance standards.

It was argued that building the motor integrally into the mechanism achieves practically all the ideal application objectives. Probably the only conclusions permissible thus far are that the single-phase induction motor is a simple, rugged, adaptable prime mover for constant-speed loads, but that proper motor application involves many factors which require extensive knowledge, skill, and experience. These conclusions seem especially true and pertinent in the design of mechanisms where the product engineer must assume responsibility for the motor and its starting accessories.

ACKNOWLEDGMENTS

The author acknowledges the generous assistance of L. Z. Gossman, Fractional-Horsepower Engineering Department, the General Electric Company, in obtaining and preparing motor data. He also is grateful for help from F. W. Suhr and K. R. Whearley, both of Fractional-Horsepower Motor Engineering, General Electric Company. Photographs were contributed by the Copeland Refrigeration Corporation, and the Tecumseh Products Company. The "Reverswitch" is a product of the Iron-Fireman Manufacturing Company.

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18 Patent No. 2320716.

Rapid-Reversal Motor

A METHOD for reversing a small electric motor in three to four milliseconds has been developed by Jacob Rabinow at the National Bureau of Standards, Washington, D. C. Designed specifically to meet the need for high-speed reversal of magnetic tapes in the memories of electronic digital computing machines, the technique may prove useful in many other applications.

In the Bureau's rapid-reversal motor, the kinetic energy of the rotor, instead of being dissipated as heat in a brake during deceleration, is converted into potential energy in a spring, which is then used to accelerate the rotor rapidly in the opposite direction.

A small low-inertia two-phase motor operating at 3200 rpm was used. The reversal spring consists of a steel torsion bar approximately 31 in. long and $^3/_{16}$ in. in diam. Only one phase of the motor is connected to the a-c power supply; thus the motor will rotate in the starting direction, either clockwise or counterclockwise. The motor shaft is rigidly connected to one end of the torsion bar, which is equipped at the other end with two positive unidirectional clutches. One clutch prevents clockwise, and the other counterclockwise, rotation. If the motor is rotating in a clockwise direction and the proper clutch is engaged, the adjacent end of the torsion bar is thereby stopped; this brings the rotor to a stop in approximately 20 deg.

The potential energy stored in the torsion bar is then returned to the rotor in the form of a counterclockwise impulse. The motor attains virtually full speed in the new direction within about two milliseconds.

In the experimental model of the rapid-reversal mechanism built at the Bureau, the clutches are operated manually, but it is expected that in normal use the clutch mechanism will be operated by suitable electromagnetic controls. Although the studies thus far have used a small motor of about $^1/_{75}$ hp, it is anticipated that motors of all sizes could be reversed rapidly by this technique, the speed of reversal being limited only by the mechanical strength of the various parts. Moreover, by use of suitable circuits, rapid reversal of motors can be obtained without producing large current surges in the electrical supply lines.

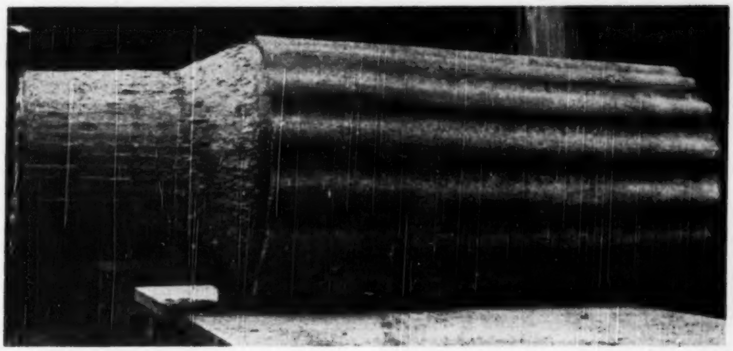

FIG. 1 52-IN-DIAM CORRUGATED INGOT FOR A LOW-PRESSURE STEAM-TURBINE ROTOR

HEAVY COMMERCIAL FORGINGS

By G. T. JONES

CHIEF METALLURGIST, HOMESTEAD DISTRICT WORKS, CARNEGIE-ILLINOIS STEEL CORPORATION, MUNHALL, PA.

MANY types of large forgings including those used in the electric-power-generating and shipbuilding industries are produced by the Carnegie-Illinois Steel Corporation. More recent production has included forgings for the yoke and pole tips for cyclotron magnets and for large anvil bases for forging hammers. Smaller forgings for a variety of applications are also produced, such as hardened forged-steel rolls for cold-reduction mills, and their counterpart, hardened forged-steel sleeves for backing-up rolls.

Large forgings require special consideration throughout their processing in order to meet specifications.

STEAM-TURBINE ROTORS

One of these is the low-pressure steam-turbine rotor. Many rotors were produced for ship propulsion during the war years, and three sizes were involved, namely, the low-pressure, the intermediate-pressure, and the high-pressure units.

Low-pressure rotors, for example, have body diameters of 35 to 40 in. and, as rough-machined, weigh 20,000 to 30,000 lb. A $1^7/_8$-in-diam bore is machined through the longitudinal axis of the rotor concentric with its outside diameter. This is done to determine the soundness of that portion of the forging and therefore is critically inspected.

Briefly, specifications require that a rotor must meet certain physical properties in radial, tangential, and longitudinal directions; that the inspection of the bore must not reveal pipe, porosity, or nonmetallics; and that the rotor must maintain dimensional stability in the heat-indication test. While there are other requirements, these are the most significant. Physical properties for a typical rotor are specified as follows: Elastic limit, minimum, 65,000 psi; tensile strength, minimum, 95,000 psi; elongation in 2 in., minimum radial, 18.0 per cent; elongation in 2 in., minimum tangential, 12.0 per cent; reduction of area, minimum radial, 35.0 per cent; reduction of area, minimum tangential, 20.0 per cent. The heat-indication test is designed to determine the dimensional stability of the rotor at elevated temperatures, from 750 to 900 F, the range in which the rotor will normally be operated. The significance of this test is readily apparent, for a rotor having excessive movement at operating temperatures could result in serious equipment damage. The composition, in percentages, of steel used is: C, 0.20 to 0.30; Mn, 0.50 to 0.80; P, 0.040 max; S, 0.040 max; Si, 0.15 to 0.35; Ni, 2.75 min; Mo, 0.40 to 0.60; V, 0.05 to 0.12.

Because the physical properties and bore soundness are so exacting, it is necessary that the steel be of a high order of cleanliness, and to achieve this the steelmaking practices must be well controlled. Steel may be made in the acid or basic open hearth or in the electric furnace. However, this discussion pertains only to basic-open-hearth steel.

In open-hearth-furnace practice, a cold charge is used with selected scrap and low-phosphorus low-sulphur pig iron. Heats are charged so that the melt carbon is in excess of 0.90 per cent. The rate of carbon drop is controlled so that it will not be greater than 0.30 per cent per hour. This rate is further reduced during the last hour. No additions of ore or alloys are made in the furnace later than one hour before tapping. The manganese residual is controlled to a minimum of 0.20 per cent. Tapping carbon is as high as is consistent with the required ladle additions and the ordered carbon range. Experience has indicated that satisfactory heats may be made in 75-ton or 225-ton furnaces with the latter being used at present.

Even though the steel produced in the furnace and tapped into the ladle is of suitable quality, there remains the necessity for satisfactory casting and stripping practices. The mold into which the steel is cast must be of a design to produce an ingot of exceptional soundness. For low-pressure rotors a specially designed 52-in-diam big-end-up mold is used. The mold has a special outside contour which tends to accelerate ingot solidification, particularly in the bottom portion. The inside contour is corrugated, a design which reduces the tendency to ingot surface cracking. The rate of rise of

Contributed by the Metals Engineering Division and presented at the Fall Meeting, Erie, Pa., September 27–30, 1949, of The American Society of Mechanical Engineers. Condensed.

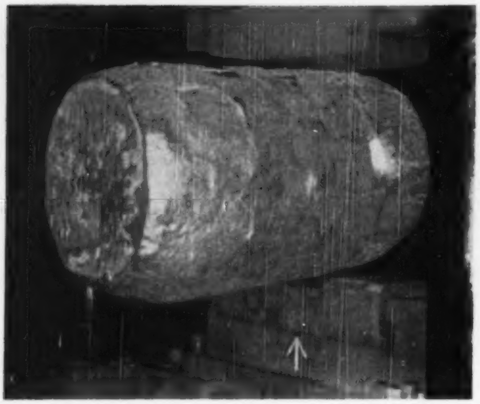

FIG. 2 UPSET-FORGED 49-IN-DIAM BLOOM READY FOR FORGING TO 44-IN. OCTAGON

The next step is to deliver the ingot, shown in Fig. 1, to a heating furnace in the forging department. Delivery time is as short as practicable since long delivery encourages the development of ingot cracks. The ingot is charged horizontally into a top-and-bottom-fired car-bottom furnace whose temperature is approximately that of the ingot—generally around 1300 to 1500 F. The ingot is equalized at this temperature and then maintained for at least 6 hr. It is then heated in approximately 15 hr to a maximum forging temperature of 2200 F, where it is maintained for about 30 hr to insure temperature uniformity before forging.

Several presses are available for large forgings, with the majority being produced on the 7000 and 12,000-ton presses. The smaller of the two presses is a recent installation and is a four-column hydropneumatic press rated at 7000 net tons with a height of 43 ft above floor level. Its columns are 26 in. in diam and are spaced on centers of 18 ft 6 in. and 7 ft 4 in. There are two main cylinders 43 in. in diam which operate at a pressure of 4500 psi. The plunger has a 10-ft working stroke at a rate of 3 in. per sec and an idling stroke at 10 in. per sec. Power is supplied by three pumps, each having a capacity of 330 gpm. Each pump is driven by a 1000-hp motor. The system includes four hydraulic pneumatic accumulators each having a volume of 2250 gal. Make-up air for the accumulators is supplied by a two-stage compressor of 16 cfm capacity at pressures from 90 to 4500 psi. There are nine car-bottom heating furnaces for this press. Of these, two are 12 ft × 30 ft and seven are 15 ft × 49 ft. These furnaces are top-and-bottom-fired with capacities from 300 to 500 tons.

The ingot is forged first to the smallest octagon or round, approximately 40 to 42 in., that will permit upset forging after the top crop is removed. Generally the length of the octagon

FIG. 3 END SHAFTS OF ROTOR COMPLETED WITH BODY STILL A 44-IN. OCTAGON

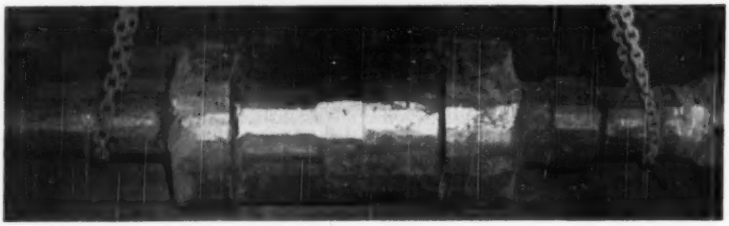

FIG. 4 FORGED STEAM-TURBINE ROTOR READY FOR HEAT-TREATMENT

the steel in the mold is controlled in order to minimize ingot cracks which often develop when the pouring rate is too fast.

After the ingot, which weighs 64,000 lb, is cast, it is held in the mold for a specified minimum time before stripping. In the case of the 52-in-diam ingot, the hot top shell is removed 10 hr after casting and 5 hr later the ingot is stripped from the mold. The stripping time is dependent upon the time required to assure complete solidification of the ingot.

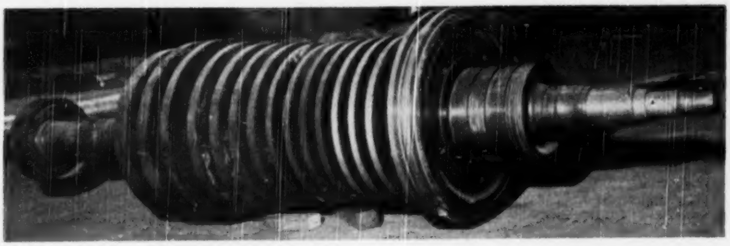

FIG. 5 SLOTTED LOW-PRESSURE STEAM-TURBINE ROTOR

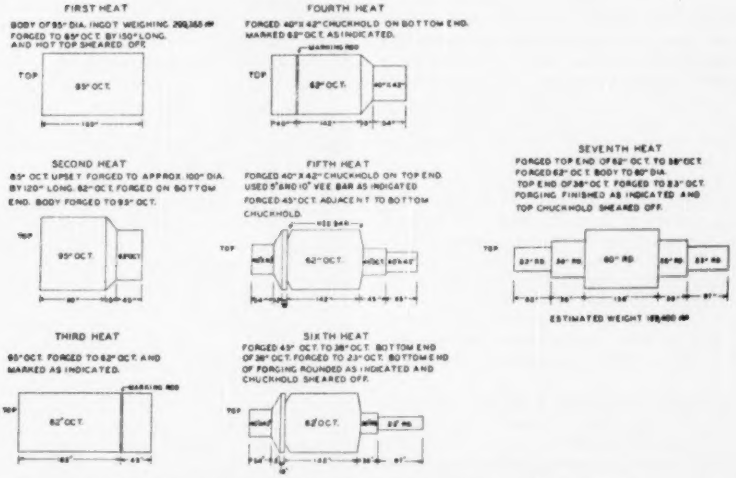

FIG. 6 FORGING PROCEDURE FOR A 60-IN-DIAM GENERATOR-ROTOR FORGING

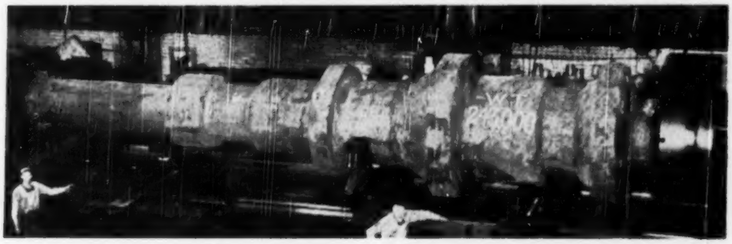

FIG. 7 WATER-WHEEL-SHAFT FORGING IN 96-IN. LATHE READY FOR ROUGH-MACHINING

or round cannot exceed $2^1/_2$ to 3 times its diameter since a greater ratio may result in bending of the forging during upsetting.

After the round is forged, the hot top is sheared. The forging is then reheated and placed under the press for upset forging. At the completion of upsetting, the diameter of the forging has been increased to 49 in. and the length reduced to 85 in. The upset forging is reheated and forged to a 44-in. octagon × 112-in-long bloom. The beginning of this operation is shown in Fig. 2. At this point it is marked for subsequent forging. After reheating, both top and bottom ends of the forging are forged to a 23-in. octagon. Following another reheating, it is forged to the size shown in Fig. 3. Another reheating and the forging is completed, Fig. 4.

Immediately after forging, the rotor is charged into a 1500 F furnace, given an annealing treatment, followed by a normalizing and tempering treatment. Following this, it is rough-machined and bored. The inspection of the bore is made at this time. The rotor is then ready for grain-refining treatment of normalizing at a lower temperature than the first normalizing and tempering. Preliminary physical tests are taken and the forging is then machined to final size, magnaflux-inspected,

and stress-relieved. Official physical tests are then made and the rotor is given the heat-indication test. This test consists of placing the rotor in a lathe, covering it with a portable electric furnace, and heating it to 850 F or higher. Both in the heating and cooling, it is rotated at 2 rpm and its expansion and contraction measurements are recorded at specific locations on the rotor. Deflection of its longitudinal axis must not be more than 0.001 in. as shown by the final hot and final cold readings. This operation completes the processing of the rotor. Fig. 5 shows a partially completed slotted rotor. At this stage it is recognized that slotting, because it exposes many transverse sections of the rotor, represents an additional severe test of steel quality.

GENERATOR SHAFTS

Generator shafts are representative of another type of large forging. Their specifications and production requirements are similar to those specified for rotors. The outstanding difference is their size and this difference necessitates the use of larger ingots such as the 70-in-diam ingot weighing 150,000 to 170,000 lb, the 77-in-diam ingot weighing 175,000 to 210,000 lb, the 95-in-diam ingot weighing 300,000 to 370,000 lb, and the 110-in-diam ingot weighing 400,000 to 500,000 lb.

The various steps in forging a large generator shaft made from a 95-in-diam ingot weighing 300,000 lb are outlined in Fig. 6. A forging of this type is usually made from a nickel-molybdenum-vanadium steel, similar to that mentioned in the rotor description. Typical physical properties required are as follows: Yield strength, minimum (0.01 per cent offset), 45,000 psi; tensile strength, minimum 80,000 psi; elongation in 2 in., minimum longitudinal, 20.0 per cent, radial, 11.0 per cent, tangential, 16.0 per cent; reduction of area, minimum longitudinal, 35.0 per cent, radial, 18.0 per cent, tangential, 28.0 per cent.

A double normalizing and tempering treatment is given the generator shaft after forging. This is followed by rough-machining, the over-all length being 32 ft $2^1/_4$ in., the body $56^3/_4$ in. in diam and 12 ft $8^1/_4$ in. in length, and the total weight being 133,500 lb.

Forgings of this type are tested, as indicated by the specification, in longitudinal, radial, and tangential directions. Here again are tests that require a high standard of steel quality. Bores in these forgings are much larger than in steam-turbine rotors. In the case of the foregoing generator shaft, the bore is $4^5/_8$ in. in diam. It is customary to stress-relieve these forgings and this is done at temperatures slightly lower than those used in final tempering. In this treatment the maximum heating and cooling rates are restricted to approximately 20 F per hr. It is believed that stress reduction is further enhanced by such a practice.

WATER WHEELS

Water wheels, which are representative of another type of large forging, form a part of the driving equipment for converting water power to electric energy. Most often these are made from large 95-in-diam and 110-in-diam ingots because of their weight and the large diameter (up to 85 in.) of their collars. The specified physical properties are somewhat lower than those of steam-turbine rotors and generating shafts. Typical requirements are as follows: Yield point, minimum, 35,000 to 40,000 psi; tensile strength, minimum, 70,000 to 75,000 psi; elongation in 2 in., minimum, 18.0 to 22.0 per cent; reduction of area, minimum, 30.0 to 40.0 per cent.

The composition, in percentages, of the steel used is: C, 0.40 to 0.50; Mn, 0.60 to 0.90; P, 0.040 max; S, 0.040 max; Si, 0.20 to 0.35; Ni, 0.40 to 0.60; V, 0.03 to 0.08.

The heating, forging, and treating practices are much the same as those employed in producing generator shafts. Bores in these forgings are from 5 to 12 in. in diam. An example of a rough-forged water wheel is shown in Fig. 7. Over-all length of this forging is 36 ft.

STEEL SLEEVES

Hardened forged-steel sleeves are still another type of forging requiring special processing. These sleeves are used for backing-up roll assemblies in hot and cold mills. In general, cast-steel backing-up rolls are furnished with hot-strip mills, plate mills, and four-high cold-reduction mills. Cast backing-up rolls are used until their minimum usable diameter is reached, and they are then machined to arbors over which hardened forged-steel sleeves are shrunk. This practice extends considerably the service life of the cast backing-up rolls. It is customary for mills to secure additional cast backing-up rolls in order to maintain a potential supply of arbors, but the practice of securing forged-steel arbors is also followed.

A sleeve for a tin temper mill is a typical example of this type of forging. It has a $42^5/_8$-in. OD, a 28-in. ID, and a $42^7/_8$-in. body length. Steel used for sleeves is generally a high-carbon (0.50 to 0.65 per cent) nickel chromium, or chromium-molybdenum grade, and it may be produced in the open-hearth or electric furnace depending upon the chromium content. Three sleeves of the size mentioned are produced from a 48-in-diam ingot weighing 72,800 lb. Fig. 8 outlines the various steps in the forging of this ingot.

The ingot is first forged to a 44-in. octagon and sheared into three pieces, each 42 in. in length. The pieces are reheated and each is upset-forged to 36 in. in length and then a $16^1/_2$-in-diam hole is punched through the longitudinal axes. After reheating, the pieces are forged on a 16-in-diam bar and the hole is expanded to 20 in. in diam. These expanded pieces are then reheated and forged on a 19-in-diam bar to a $39^1/_4$-in-octagon and the hole is enlarged to 21 in. Reheating is followed by a forging of the ends to a level contour. After the final reheating the sleeve is forged on a 19-in-diam-bar to 26 in. ID, $44^5/_8$ in. OD, and approximately 53 in. in length.

After forging, the sleeves are heat-treated to secure the desired microstructure for the subsequent hardening treatment. After heat-treating and rough-machining, the sleeves are hard-

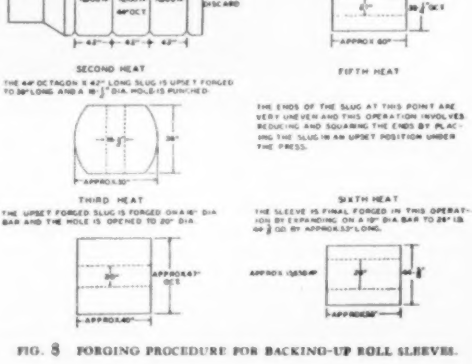

FIG. 8 FORGING PROCEDURE FOR BACKING-UP ROLL SLEEVES.

ened by water quenching and tempering, in this instance to a hardness of 70 to 80 Shore scleroscope.

Larger sleeves have been made, and in Fig. 9 is shown what is believed to be the largest sleeve ever produced. This photograph shows the sleeve and arbor assembly for a 160-in. plate mill immediately after the sleeve has been shrunk on its forged-steel arbor. The arbor has an over-all length of 25 ft 3 in., and its machined weight is 98,300 lb. The sleeve has a 59-in. OD, a 43-in. ID, and is 154 in. long. It weighs as rough-machined, 55,130 lb.

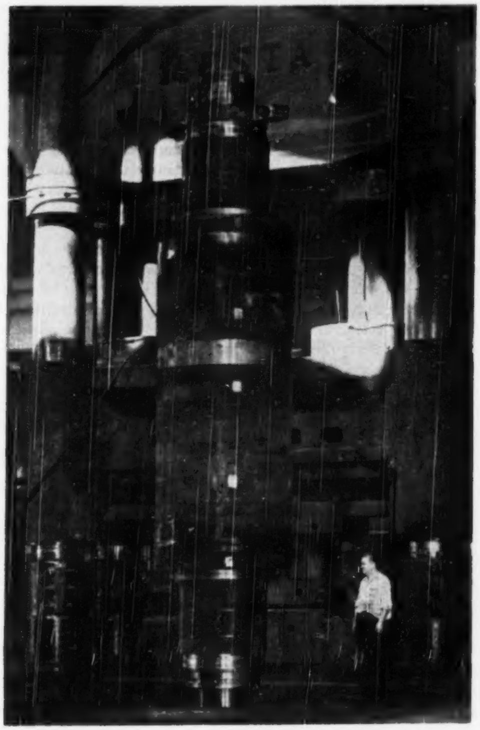

FIG. 9 SLEEVE AND ARBOR ASSEMBLY FOR A 160-IN. PLATE MILL

ANVIL BASES FOR HAMMERS

Anvil bases for hammers, another type of large forging, are a recent development and present one of the most difficult handling problems in forging. The steel used is generally 0.25 to 0.35 per cent carbon with the addition of a grain-refining element. The ingot sizes used are rectangular in cross section, an example of which is an ingot $69^3/_4$ in. × $156^1/_2$ in., weighing 503,000 lb.

The forging of an ingot of this size is accomplished on the 7000-ton press in the following manner: The ingot is first forged to reduce the $156^1/_2$-in. dimension to 125 in.; reheated and forged to a thickness of 61 in.; reheated and forged to bring the width back to 125 in. since it had spread in the previous forging. In addition, the top and bottom discards are taken at this time so the forging has the approximate dimensions of 61 in. × 125 in. × 155 in. After the foregoing operations, it is reheated and a double fuller tool is used on one face to flare the 61-in. dimension to 82 in., with the 125-in. dimension being reduced to 107 in. and with the opposite face spread to $62^1/_2$ in. The flared face is then forged to a flat surface. The forging is reheated and placed with its ends on the press dies. These ends are forged to a reasonably level contour, reheated, and the $62^1/_2$-in. dimension reduced to 61 in. The forging is again reheated and the sow block seat forged in the 61-in. face using a 23-in-diam die. See Fig. 10.

The anvil block is given a normalizing and tempering treatment after forging. The size of the forging compared to the press opening between columns and dies illustrates well the problems that must be considered in its production on the 7000-ton press. Machining on this forging was required on the top and the bottom faces as well as on the sow block seat. The weight of this base, as forged, was 290,000 lb.

There has been slight mention of press size in this paper, but it is considered desirable practice to employ the largest available presses for the forgings just described. Work penetration is necessary and particularly so when a forging requires a small bore for critical inspection purposes. It is believed that the penetration is not only a function of draft, but of die width also, and for this reason the large presses with their wider dies are favored. Drafts used on most of these forgings are normally from 3 to 4 in. after the ingot corrugations have been forged.

This schedule is followed until the forging is almost complete when drafts are reduced to approximately 2 in. Heating times for large ingots are exceedingly long and for the 110-in. and 95-in-diam ingots, when charged immediately after stripping, are 110 and 95 hr, respectively. The heat-treating of these forgings requires extreme care; the furnaces used are generally underfired and equipped with sufficient thermocouples to enable the operator to secure temperature uniformity.

SUMMARY

This paper has aimed, in a brief way, to cover the scope of the large-forging industry. Several types of these forgings have been discussed in some detail. Their production necessitates the use of large equipment which must be well controlled to produce forgings that meet specifications. To do this means that both the actual processing and the planning that precedes it must be carefully and thoroughly performed.

FIG. 10 FORGING SOW BLOCK SEAT IN ANVIL-BASE FORGING

Training for Transition to PROFESSIONAL RESPONSIBILITY

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INTRODUCTION

THE U. S. Department of Defense is the largest and most diversified single enterprise in the world. The preservation of our American way of life demands that it also be one of the best. In order to attain and maintain its superiority, it spends a considerable proportion of its money each year on engineering research.

A substantial part of this research is farmed out to private concerns and to educational institutions. Some of it, on the other hand, is done by the Armed Forces themselves when private groups are not equipped with the facilities or specialized man power required to do it. One of the fields in which private groups have relatively little training or facility is that of ordnance. There is no "open market" for guns, mines, depth charges, torpedoes, rockets, missiles, bombs, and the like. For its part the Navy has been forced, with a few exceptions, to develop these things itself.

This has brought about the rise of a relatively new profession which, for our present purpose, we will call *ordnance engineering*. It is unlike its sister professions such as automotive and marine engineering in that the Navy cannot look to the colleges or to private industry to produce specialists in this field. It must turn them out itself.

A mechanical engineer who is well on his way to professional competence in the field of ordnance will have specialized in one or two supporting fields. It may be the design of rockets, wind-tunnel components, or shock-test machines; or it may, for example, be the design of instrumentation for research in hydroballistics. On the other hand he may have selected the research and development aspects or ordnance-evaluation technology, ranging from the design of instrumentation for research in environmental conditions at the earth's poles, to testing in the laboratory the resistance of ordnance items to exposure to simulated conditions. The basic fact is that the art of creative ordnance development is supported by the fields of pure and applied physical science, and depends vitally on the research taking place in them.

The Naval Ordnance Laboratory employs about 2100 civilians of whom, roughly, one third are professional scientists and engineers. Of these, the mechanical engineers are the largest single group, with physicists a close second. They are distributed principally among three operating technical departments, namely, research, engineering, and technical evaluation.

Mechanical engineering plays a vital role in each of them, as they each represent a major stage in ordnance development. The junior mechanical engineer at NOL has thus an opportunity to become oriented in his profession under circumstances at least as diversified as those in any other research and development laboratory in the nation.

Contributed by the Education Committee and presented at the Spring Meeting, Washington, D. C., April 12-14, 1950, of The American Society of Mechanical Engineers.

THE JUNIOR PROFESSIONAL-TRAINING PROGRAM

Junior engineers are normally employed by the Laboratory at the end of their junior year in college and spend that summer working under the supervision of experienced engineers. They then may go back to college to obtain their bachelor's degrees. If their summer work was excellent, they may return to the Laboratory to continue their employment on a regular basis. They now find themselves in an intensive training and evaluation program. Each trainee is rotated individually from one laboratory section to another, spending two months in each, until he has been under the independent supervision of four experienced engineers, in four different types of ordnance-engineering activity. These may include ordnance-engineering research, design, development, testing, or evaluation, both in the laboratory and in the field. During this period he also receives classroom instruction in the fields of ordnance; Laboratory plant, facilities, and instrumentation; Laboratory technical project administration; and he also attends refresher sessions of five hours each in curve fitting, evaluation of experimental data, technical-report writing, and patent law.

Alternatively, junior engineers may be employed at NOL as part of a co-operative engineering-education plan such as we have with the Massachusetts Institute of Technology. Under this plan, students work at the Laboratory and study at the Institute, alternating in pairs at four-month intervals. These employees, however, spend *four* months in each of four rotational billets, but attend the same orientation classes as the other junior professional trainees. At the end of the program they receive their master's degrees from the Institute and are assigned permanently to our staff at the assistant-engineer level. Currently we have with us 22 junior professionl trainees (mathematicians, engineers, and physicists) of which four are M.I.T. electrical-engineering co-operatives. The M.I.T. students are required by the Institute to work on a thesis problem as a prerequisite to graduation. The arrangements for this are described below under the graduate-study program.

In either case, each trainee is evaluated by the personnel department, at the end of this rotation and classroom term, on the basis of the reports turned in by his four supervisors, on his own progress reports, on his grades, on his classroom examinations, and on the results of three so-called "patterned interviews" he has had independently with three members of the training-division staff. Using these evaluations, the technical departments fill their junior organizational vacancies from this pool of trainees, who in turn are now expected to be able to assume their responsibilities on a junior-engineer level. Those not selected in this process are dropped from the rolls.

This rotational plan has two important advantages to the Laboratory: First, the trainee has an opportunity to "find himself" professionally in one or more of the basic engineering activities; second, the Laboratory has an opportunity to collect, "under forced draft," valid and reliable personnel-inventory data on each trainee. It is our principal basis for assigning, or terminating the employment of, the junior professional

employee in a manner most advantageous to us and to himself.

Mechanical-engineering students may be interested in knowing what our mechanical-engineering supervisors look for in their trainees while evaluating them. They naturally expect the trainee to display fundamental engineering knowledge on the level expected of him while in college. In addition to this, they would like to see definite evidence of the development of certain skills and attitudes of which the following are cited as suggestive:

1 *Skills.*

a Ability to make and read a mechanical drawing with proficiency.

b Ability to design creatively and inventively.

c Ability to devise a test procedure.

d Ability to use all the machines in the staff shop.

e Ability to use the English language, especially in reports.

f Ability to plan and co-ordinate those parts of his assignment which must be performed by service groups.

g Ability to work in close harmony with the other persons in his immediate group.

2 *Attitudes.*

a An awareness of the importance of checking his own work. (His college answer books are of little use to him now in this respect.)

b An inclination to do his own drafting.

c An appreciation of the capabilities and limitations of the machines in the staff shop in relation to the projects he is working on.

d An awareness of how his own work fits into that of the rest of his group.

e An active interest in his own professional development, whether by formal or informal courses, related reading, or by contact with more experienced persons.

f Arrival at work in the morning with an attitude of interest and expectancy.

g An appreciation of the importance of channeling his interests, so as not to spread himself too thin.

h A willingness to adapt himself wholeheartedly to the demands of the job.

i A liking for variety in his daily work schedule, as, for example, between designing, drafting, and testing.

The foregoing items were culled from the initial results of a survey the training division is conducting to find out what criteria our mechanical-engineering supervisors are actually using (consciously or unconsciously) when deciding whether to recommend junior mechanical engineers for promotion to assistant mechanical engineers. Since such promotions frequently occur after one year of experience, these items have considerable relevance to our present discussion.

It may be correctly inferred from the foregoing list that junior engineers succeed or fail in our training program, not only because of what they may or may not know, but also because of the skills and attitudes they display. It is trite, but true, that it is not so much what one knows that counts, but what one can do with what one knows. Perhaps the man who first expressed this thought was an engineer at heart.

If our junior engineer has jumped the summer and winter hurdles successfully, he may take full advantage of the NOL graduate-study program.

THE GRADUATE-STUDY PROGRAM

Through a co-operative arrangement with the nearby University of Maryland, the Naval research agencies in the Washington area have been able to set up a large variety of graduate scientific and engineering courses on Government premises during late-afternoon hours. They are taught in most cases by Government scientists whom the University appoints to its faculty for this purpose. Full residence credit is given by the University toward advanced degrees in the physical sciences, mathematics, and engineering. During the fall term, 1949, eight of these courses were held at The Naval Ordnance Laboratory and 204 of its employees were enrolled in the interagency graduate-study program. Through arrangements concluded with two graduate schools in the vicinity, there are now four candidates for the doctorate employed by the Laboratory on Naval research projects which also satisfy the thesis requirements of those institutions and will be fully accredited by them for degree-granting purposes. Through similar arrangements with these and other graduate schools in the East, there are an additional 21 candidates for the master's degree. In order to assist younger employees in pursuing planned and coherent academic programs as opposed to haphazard accumulations of credit hours, an informal advisory committee on graduate study has been established at the Laboratory. It is composed primarily of those members of the Laboratory's staff who have been appointed to the University faculty.

This committee provides assistance in two other directions: (1) to the NOL training division to provide counsel on the extent to which the program is living up to its in-service character, and (2) to the University to keep it advised on the extent to which academic standards are being maintained. The program begins its class sessions one-half hour before the end of work each afternoon. Employees are given this half hour as "official business" if the courses in question are definitely related to their professional advancement on their present or anticipated jobs. If the courses are not, the time must be compensated for by the employee by taking leave, readjustment of working hours, or a combination of both. Each individual case is judged initially at the first line of supervision. Although this policy necessarily produces some inequities as viewed across organizational lines, no grievances have ever reached important proportions. This is fortunate, since the first line of supervision is the management level on which specific training needs can be determined with greatest validity. A course in wind-tunnel design, for example, might be quite necessary to the professional development of a mechanical engineer working in aeroballistics; an otherwise similarly qualified engineer working on ordnance-vibration problems would, on the other hand, compensate the government for official time spent in a course so obviously unrelated to his current specialty.

In order to make this policy workable, the training division, with the committee's assistance, has drawn up a core list of approximately fifty courses which the Laboratory feels are directly related to the academic knowledges and skills required of our technical workers by the research and development programs to which it is committed. The list is reviewed periodically to make certain that the knowledges and skills taught do not lie materially outside the scope of the Laboratory's technical mission, and that enough courses are included to give this mission adequate academic support and to give the student a maximum of academic freedom. Thus not all the courses for which there may be employee demand are offered, only those on the core list. Persons desiring to take non-core-list courses may take the fifteen-minute drive by auto from the Laboratory to the University campus, and arrange to be away from work through one of the methods mentioned earlier.

The entire core list cannot be reproduced here; however, the strictly mechanical-engineering portion may be of interest:

Theory of Sound and Vibrations	Advanced Machine Design
Advanced Fluid Dynamics	Advanced Aerodynamics
Theory of Elasticity	Advanced Metallurgy

The remaining courses in the core list, particularly those in physics and mathematics, provide the remainder of the framework within which a mechanical engineer employed at the Laboratory may plan a complete graduate program. Instructors in the program must, of course, compensate for the half hour of government time spent teaching each class. Two Saturdays' extra work per semester usually take care of this.

The committee also assists in locating, out of the technical programs the Laboratory is working on, suitable "unclassified" thesis problems for accreditation both on the master's and doctor's levels. An employee who is a candidate for an advanced degree is, whenever possible, assigned to an appropriate unclassified laboratory problem of his own choice. The problem then becomes an official assignment and is worked on during regular working hours. If he finds the choice of NOL problems too restrictive, he may choose his own, and work on it at NOL or at the University out of hours. In some cases graduate students at distant universities have, with faculty encouragement, accepted employment here because of the opportunity to work on problems for which our facilities were especially suited, and for which the University had accordingly expressed willingness to grant credit toward the thesis requirement. In such instances the accrediting University appoints a senior member of the Laboratory's staff to its faculty (with or without pay) to supervise the thesis in the University's interests. Academic institutions vary widely in their willingness to accredit thesis work done in these circumstances. The trend has been, however, in the direction of favoring this scheme when benefit to the student has been established.

The actual arrangements between the University of Maryland and the Naval activities in the Washington area are carried out directly and informally. A co-ordinating committee, known as the Science Training Group, acts as a sounding board and policy-recommending body for the Civil Service Commission's Advisory Committee on Scientific Personnel, of which it is a subcommittee. All the interested government agencies are represented on it.

CIVIC RESPONSIBILITY

A young engineer's transition to professional responsibility will be helped along not only by such formal programs as we have just described, but also by the informal and unofficial professional climate the Laboratory is able to maintain. Thus he is a frequent target of the perennial membership drives put on by the engineering societies through their local sections. (NOL alone has 70 of your members, and there is no escaping them!) He is invited to their meetings, and if he is wise, he will participate actively in the affairs of one of these local groups. The Laboratory publishes a semi-annual directory of employees affiliated with professional societies, and his name may soon appear on it.

In the meantime, notices come to his desk of in-service seminars and colloquia, held at NOL or other government laboratories nearby, on subjects which may be of interest to him in his regular work. After four or five years he may be asked to speak briefly on his own work or even to preside at one of these meetings himself. When he gets to this point he is ready to take the big step—presentation of a paper at a regular meeting of his society, and later, its publication in its journal. To encourage the writing of technical papers for presentation at society meetings and for subsequent publication, the Laboratory publishes internally a quarterly report of the activities of its scientists and engineers in this field of professional endeavor.

COMMUNICATIONS SKILLS

To further assist this group along these lines, the Laboratory runs a course in technical-report writing. It is regrettable but true that proficiency in engineering is not always associated with proficiency in reporting on its results. The course is slanted toward our own organizational needs and is taught by employees who are well qualified in this field.

Another occasional weak spot in the engineer's communications kit is in thinking and speaking effectively *on his feet*. True, colleges have gone to some lengths in setting up courses in public speaking for the engineering student. But alas, the situation often tends to be academic. The motivation that should be provided the student by being periodically put "on the spot" as his group's official speaker is too often absent. It is, however, very much present in an NOL-employed engineer, and accordingly, the learning curve tends to be much steeper and to flatten out much later. Further, we are most fortunate in having the services of Prof. Henry G. Roberts, formerly of George Washington University, who showed great insight in the development of our public-speaking course. Instead of constructing it along traditional academic lines, he used a dozen or so typical "public"-speaking situations most engineers sooner or later have to face and framed his course around them. What engineer of a few years' experience, for instance, has not had to make an announcement, read an unfamiliar piece aloud, explain how to perform a given operation, or explain what he does for a living? Because the course provides instruction geared to these and other similar situations, the student motivation is keen and opportunities to practice in actual Laboratory situations are plentiful. The Laboratory's official policy, incidentally, is to make the course available only to those employees whose superiors have already completed it.

The "advanced course" is then given through the medium of our official technical-progress meetings. Professor Roberts participates indirectly in the formulation of the agendas and in the setting of the time limits on each speaker. The speakers are required to rehearse their presentations in preaudit meetings in which he makes suggestions as to the arrangement of their material in the interest of lucidity and audience appeal. Wire recordings are made and played back. It is a quirk of human nature that, to us, no one's vocal manner is as attractive as our own; that we never make poor presentations ourselves—we only sit through the poor presentations of others. Most of us can remember the shock we experienced when we heard our voices played back for the first time in our lives. As far as I know, all of the NOL papers presented at this convention have been preaudited by Professor Roberts. If you don't like the result do not blame him. Rather, consider what a beating you might have taken if he had not been asked to run the interference!

We all know that in large companies a great deal of the engineer's time may be spent in discussion meetings. These are usually called for one or more of the following reasons: (1) to develop support for required action, (2) to consider unsolved problems, (3) to settle disagreements and get group agreement.

To be successful, such meetings must display full participation; they must get consideration for all relevant opinions, viewpoints, and experiences; they must stay on the subject and they must not be used to settle personal conflicts and arguments. Most important, they should close with complete agreement, even if that agreement must be on the points on which agreement cannot be reached within the time allotted. Skill in directing discussion meetings may be gained with practice under the guidance of a skilled instructor. In recent months we were able to conduct two training programs in discussion leading and in both cases the group consisted of a superior and his immediate subordinates. Actual operating problems were used for discussion

(Continued on page 640)

MANAGEMENT *and* *Its* CRITICAL OPPORTUNITY

By ARTHUR B. GREEN

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TECHNICALLY, it is management that inspires and guides the interplay of "land," "labor," and "capital" for the creation of wealth, and management has these same three elements to deal with everywhere, under all of the "isms." That is a sweeping function, the full competent exercise of which in the fluid relationships and interweaving interests of people would set off management as the guide, not of the economics only, but also of the culture, morals, organization, and affairs of society. It is quite safe to consider that nothing is more essential to civilization or calls for sounder character and higher consecration than good management, so when the engineer steps forward to play his part in it he can well admonish himself: "Put off thy shoes from off thy feet, for the place whereon thou standest is holy ground."

The practical factors relating to any enterprise, given in the order of their first appearance as the enterprise gets under way, are site, building, machinery, tools, materials, labor. Labor means of course all labor, top, bottom, and intermediate. It is sobering if not humiliating to have to notice at this late day the peculiar fact that all of the first four are subject to specification. No one would think of contracting for any one of these except on specification. But today, when it comes to labor, so much an hour (or some other interval of time) is about all that we know how to say, and we fail to pause long enough to remember that this specifies exactly nothing. We shall come presently to an amendment that the time-study man might offer on the point, but whether the amendment passes or not, in the main at any rate, so much an hour sums up our thinking. That is as humiliating as a stone in the shoe, for the first four of these practical factors derive their values entirely from the value of labor, the fifth. If any one of the five needs specification, it is labor.

SCIENTIFIC MANAGEMENT

It was to break that vacuum, at least on the practical level and at the start, that scientific management came forward about 60 years ago. By using the methods of engineering, intense and consecrated men founded the science and art of purchasing and directing labor on engineering specification. They, too, when they said labor, meant all labor, top to bottom. Once they had set out to run down the problem on the practical level, they found themselves in something higher; in fact, they were on the threshold of a deep and vital philosophy, and they addressed themselves to it so that laboriously and gradually they might mature it in their day. The extent to which they succeeded will not fail to impress those who read what was written in the closing days of their era, a few years before World War I, provided the reading is attentive.

First there was a reconsideration of the purpose of management. The new definition of this purpose so broadened it as to demonstrate how necessary it had been to reconsider (1).[1] Latent in that definition, and so in the very beginnings of scientific management, is the thought that management is more than something applied by a top group to an organization, but equally applies to everybody; and when the principles are more fully unfolded, there is a thoroughgoing reconsideration of the responsibilities. These required such complete revision as to transfer the great bulk of them then carried by the workmen over to the management, and to enlarge and elaborate the management to receive and discharge the new responsibilities. What this rearrangement amounted to, if perhaps not always explicit in the writings, was to turn the organization virtually upside down, placing management at the service of labor (2). No doubt there were quite enough emotional hurdles for the movement to take without insisting too obviously on this blow to the pride of position; but if insistence had been unrestrained, it would have been quite in line with the doctrines of economics, for in economics there is general agreement that actually labor employs capital, not capital labor.

Wherever scientific management went into full and correct operation, it returned impressive increases in production, often 300 per cent or more, coupled with improved workmanship and higher quality, drastically lower cost per unit, increased profit, and higher wages, the last two surpassing anything that was otherwise possible. Such wastes as fatigue, injuries, and spoilage dropped steadily toward zero. And what in the long run was even better, there was accelerated improvement in methods and tools by having everyone interested in improvement and pushing for it.

"Full" and "correct" had to be the bywords, for terrible mistakes could be made, and proper cautions were emphasized carefully. Since men and women are individuals and the object was to bring each individual to his highest, "each individual must be dealt with separately as a person, not in gangs or by classifications" (3). That was the first caution, and the second was similar: "Never mistake the mechanism of management for the essence, or underlying philosophy," since the mechanism can be turned to evil purpose as well as good by those who have too little character and too low an aim (4). Then too "take plenty of time and do not try to go fast" (5). Many habits have to be changed, many assumptions modified, many prejudices violated, and it is necessary, therefore, to make sure that one man is convinced and happy before pushing on to the next.

SCIENTIFIC MANAGEMENT ILL RECEIVED

Science, art, philosophy as all this was, it was not written in the language of modern salesmanship and could not have been. To get it in the mind and in the heart called for candor, accuracy, unalloyed truth, and perhaps most difficult of all for top officials, critical self-examination. It was a proposal impossible to present on the basis that "the customer is always right." Inducement might have been found in the exceptional profits attainable—this was of course before "excess" profits were taxed—if the price had not included considerable humbling of high office and, worse, quite a load of thoughtful study. Such were the main sales resistances where those at the top

[1] Numbers in parentheses refer to appended Citations and Bibliography at the end of the paper.

Contributed by the Management Division and presented at The Fall Meeting, Worcester, Mass., September 19–21, 1950, of The American Society of Mechanical Engineers.

were otherwise reasonably well disposed, but the movement stirred up resentment if not alarm in those who assumed that someone from outside was going to tell them how to run their business. Resentment and alarm stirred, too, in the halls of labor organizations, where it was assumed contrariwise that scientific management would be grasped eagerly as a nefarious tool of oppression.

But if scientific management could not be peddled in cellophane and silk ribbon, travesties on it could. Just after the turn of the century, the ink had hardly dried on the classic papers on the subject when commercially sharp exploiters in droves, armed with slide rules, charts, and stop watches, were rushing like troupers from plant to plant carrying high-speed improvements on what the classic papers had presented. No need to assume any new responsibilities, they promised. Stay in the office and worry about nothing. Simply leave everything to them. They had bonus charts that could not go wrong, and foolproof "systems." They took workers in groups, applied tables of averages from stop-watch notes, and in a matter of days had whole departments "systematized." The one thing they did with thoroughness was to ignore the three vital cautions which they had heard emphasized, and they did use some of the mechanisms of scientific management without bothering with the essence, the underlying philosophy, the animating spirit.

Possibly the significance of that was not so much in the self-styled "efficiency engineers" as in the business and industrial leaders who bought their wares, for over a period of about 12 years it was these glittering high-pressure men who were kept busy, and the slower-working scientific-management men who understood their work found a slim market that in fact rapidly faded out. Such a choice on the part of business and industry could not be entered as a credit. When the rush was over of course the exploiters gradually disappeared, leaving only the comparatively few who clung, and still cling, to the assumption that the three main cautions need not be taken too seriously, and that quite a good deal of good can be done without seeking what Taylor called "the almost complete mental revolution" on the part of those at the top toward their responsibilities. Taylor insisted in full candor that top management is more heavily involved than bottom labor, and must take the initiative. Unless management plays its full part in the design and execution of each and every individual operation, valid specifications are not written for the job, and there are no reliable specifications for the purchase and guidance of labor. It is on this point that the modern time-study or job-analysis man falls short. It is on this account that, notwithstanding what has been written, developed in practice, and for a time demonstrated, there is still no way to write specifications for labor, the one factor from which all other factors derive their values. That is why so much an hour (or some other interval of time) is still about all that we know how to say.

The ill reception of scientific management is not fully recorded until the behavior of the engineers themselves is accounted for. Unable to sell, even those most closely associated with it, when it seemed promising, abandoned it for something safer. There was little if any chance by that process to get the necessary "almost complete mental revolution," and what might have been leadership fell apart. This was a choice on the part of engineering that likewise could not well be entered as a credit.

THE RESULTING SITUATION

The essence, the underlying philosophy, the animating spirit of management was not found 40 years ago and remains to be rediscovered. There is still no way in vogue to deal fully, adequately, scientifically with each separate person as an individual, so the trend toward mass dealing, instead of being replaced, was stepped up. Historically, this trend appeared first at the top and later, as a measure of defense, at the bottom. Unavoidably that trend led away from freedom, toward the regimentations of collectivism. The kind of person designated as an "employee" escapes from one tyranny by signing up with another, and under both becomes more and more identified by a number. He is heard from less as a man and more as material for statistics. Instead of rising up to his individual highest with the friendly help of management scientifically given, he is pressed down to the level of a general average; moreover, he is taught to withhold his best for fear of getting cheated. Self-interest at the top and self-interest at the bottom are presumed to be opposed. As the two seek allies for mass strength, there are all the elements of war, softened and restrained periodically by treaty, but never ending, using up an already great and still growing amount of political legislation and administration because that is the only way for the public to assert its interest. War at home in peacetime unavoidably favors war abroad. Both types of war carry the same kind of costs and wastes.

Self-interest at the top and self-interest at the bottom contend principally over division of gross income, each side trying to protect itself against aggression by the other, one result of which is protective rather than productive thinking. That predisposes against improvement as it predisposed against scientific management, particularly against the class of investigation and research necessary for the design of an operation. In the paper industry, for example, there is a trade association, a sales fraternity, an association of superintendents, an association of technicians, a co-operative institute of research and graduate technical training, some special university courses, forest-products laboratories under the Government, and an excellent set of textbooks on the manufacture of pulp and paper, but not a word directed at the task of ascertaining and defining specifically what any individual must do to perform one job on any one day in the best manner, with the most suitable materials and the best implements (6). In parallel, for converting pulp into paper, the machinery was established very much as it is now as early as 1878 and has not advanced in principle since, even under the impact of the mill laboratory which was pioneered some 20 years later and several thousand technicians who have been added in the last 35 years (7). Furthermore, the task of advancing implementation has slipped from mill management over to outside machinery manufacturers.

Under the impact of scientific management, when it seemed promising, research was carried out at one mill which yielded two results, at least in initial or preliminary form: precision methods of predetermining the papermaking properties of a pulp or slurry, and a critical measurement on which can be based a control curve governing the preparation of stock, which is formed of differentials in viscosity against time. A "single" viscosity measurement can be read as showing density (proportion of solids to liquid), which has little to do with operation design and involves the management very little; a "series" of viscosity measurements for a period of time can be used as a control curve, putting the so-called stock preparation on a precision basis and involving the management in a good deal of new responsibility (8).

That method of control and that degree of operation design were in use throughout the mill for more than 13 years and ended. The management dropped that responsibility and retained the viscosity principle only to measure density, which carried no responsibility. Likewise, all that the rest of the industry has gained from the viscosity principle is measurement of density, which involves the management in almost nothing. Papermakers are still as far as ever from knowing before the

stock goes over the machine what it will make, and as far from guiding the stock-preparation men with precision; uniformity and grade and color matching, together with machine speed and rate of waste, are still as much out of hand.

Those who feared that someone from outside would tell them how to run their business are taking orders from outside governing such matters as wages, hours of work, methods, material and tools, craft skills, pricing, health and safety, and financing. Profits above a fixed level are now "excess" and go for taxes, while the books are open to scrutiny by a variety of outside agencies. The accounting is elaborated at their expense not only to conform with outside requirements but to prepay all of the inside income taxes. As scientific management, so far as it was demonstrated, appeared to do better for all parties at interest, it is likely that it could have displaced the outside compelling agencies by avoiding the abuses they are aimed to correct and by increasing gross income before dividing it. Scientific management did not use strait jackets and would not have put anyone in them.

On the accounting side, too, the lack of any means of specifying with regard to labor, since it is from labor that all other values spring, brings on inevitably most of the fluctuation in the value of money. This value everywhere generally sinks, with special acuteness in a war and afterward, and the uncertainties of it are among the most serious, and the suffering from it can be justified by no accomplishment.

Turning to the moralities, while business and industry continue with mass dealing and its peacetime warfare; while individuals remain on guard protectively; while limited work, top and bottom, seems more advantageous than full work; it is likely that work will continue to be something to escape from and not something to relish.

Summing up, it would be difficult to think of ways of dealing within business and industry more awkward, more wasteful, more restrictive, more collectivist, than mass dealing, and more likely to grow worse. As it comes to be recognized in psychology and medicine, men are individuals and reach their highest capacities individually. To reach the highest possible values in all the factors, the first thing is to develop and inspire each and every individual as a separate and distinct person to his personal highest. It was Taylor who used to remark that any factory is first of all a man factory. And he was talking engineering.

THE WAY OUT

The progressive weakening of management as a function and a power in the United States and the world over, and the accompanying trend toward collectivism and mass conflict, if continued, can so weaken society as to endanger industrial power-using civilization. No less than that is the magnitude of the problem. How it may be solved is harder to forecast and calls for bold new thinking, high resolve, and strong imagination. Management as now constituted certainly has been offered one excellent chance and has not gained by it, chiefly by being unreceptive. If it would now change of its own accord, what has been lost would be principally time; but there appears no evidence of impending change. The problem waits for some other agency. But if it can be strongly attacked and thoroughly solved, that will provide one of the most brilliant opportunities in the history of mankind.

It is scarcely up to the standards of engineering to face a problem without producing some practical solution. If engineers address themsleves once more to this problem, and this time do not abandon it, success can follow. The plan or manner of going about it cannot now be blueprinted in any detail, but effective councils of competent men and women have been organized before on problems of wide scope and deep significance. To contribute toward the problem in hand, a member of such a council must understand and embody the essence, the underlying philosophy, the animating spirit of management, and see it as one of man's most cultural and civilizing forces.

A proper council on this problem would not end with deliberation, but would have to find or develop means of carrying sound principles into real practice, on a wide enough basis to demonstrate this time beyond doubt or even attack. From the purely professional character of the engineer this might come hard, but, unless it is accomplished, the job will not be finished in a way to stick, and whatever needs doing has not usually been found beyond engineering capacity.

CITATIONS AND BIBLIOGRAPHY

1 "The principal object of management should be to secure the maximum prosperity for the employer, coupled with the maximum prosperity for each employee.

"The words 'maximum prosperity' are used, in their broad sense, to mean not only large dividends for the company or owner, but the development of every branch of the business to its highest state of excellence, so that the prosperity may be permanent.

"In the same way maximum prosperity for each employee means not only higher wages than are usually received by men of his class, but, of more importance still, it also means the development of each man to his maximum state of efficiency, so that he may be able to do, generally speaking, the highest grade of work for which his natural abilities fit him, and it further means giving him, when possible, this class of work to do."

"The Principles of Scientific Management," by Frederick W. Taylor, Harper & Brothers, New York, N. Y., 1911, p. 9.

2 "The body of this paper will make it clear that, to work according to scientific laws, the management must take over and perform much of the work which is now left to the men; almost every act of the workman should be preceded by one or more preparatory acts of the management which enables him to do his work better and quicker than he otherwise could. And each man should daily be taught by and receive the most friendly help from those who are over him, instead of being, at one extreme, driven or coerced by his bosses, and at the other, left to his own unaided devices." Ibid., p. 26.

3 "When one ceases to deal with men in large gangs or groups, and proceeds to study each workman as an individual, if the workman fails to do his task, some competent teacher should be sent to show him exactly how his work can best be done, to guide, help, and encourage him, and, at the same time, to study his possibilities as a workman. So that, under the plan which individualizes each workman, instead of brutally discharging the man or lowering his wages for failing to make good at once, he is given the time and the help required to make him proficient at his present job, or he is shifted to another class of work for which he is either mentally or physically better suited....

"Perhaps the most important of all the results attained was the effect on the workmen themselves. A careful study into the condition of these men developed the fact that out of the 140 workmen only two were said to be drinking men. This does not, of course, imply that many of them did not take an occasional drink. The fact is that a steady drinker would find it almost impossible to keep up with the pace which was set, so that they were practically all sober. Many, if not most of them, were saving money, and they all lived better than they had before..... It would have been absolutely impossible for anyone to have stirred up strife between these men and their employers. And this presents a very simple though effective illustration of what is meant by the words 'prosperity for the employee, coupled with prosperity for the employer,' the two principal objects of management. It is evident also that this result has been brought about by the application of the four fundamental principles of scientific management." Ibid., pp. 69, 72.

4 "The mechanism of management must not be mistaken for its essence, or underlying philosophy. Precisely the same mechanism will in one case produce disastrous results and in another the most beneficent. The same mechanism which will produce the finest results when made to serve the underlying principles of scientific management, will lead to failure and disaster if accompanied by the wrong spirit in those who are using it." Ibid., p. 126.

5 "The first few changes which affect the workmen should be made exceedingly slowly, and only one workman at a time should be dealt with at the start. Until this single man has been thoroughly convinced that a great gain has come to him from the new method, no further change should be made. Then one man after another should be tactfully changed over. . . . .

"As a warning to those who contemplate adopting scientific management, the following instance is given: Several men who lacked the extended experience which is required to change without danger of strikes, or without interference with the success of the business, from the management of 'initiative and incentive' to scientific management, attempted rapidly to increase the output in quite an elaborate establishment, employing between three thousand and four thousand men. Those who undertook to make this change were men of unusual ability, and were at the same time enthusiasts and I think had the interests of the workmen truly at heart. They were, however, warned by the writer, before starting, that they must go exceedingly slowly, and that the work of making the change in this establishment could not be done in less than from three to five years. This warning they entirely disregarded. They evidently believed that by using much of the mechanism of scientific management, in combination with the principles of the management of 'initiative and incentive,' instead of with the principles of scientific management, that they could do, in a year or two, what had been proved in the past to require at least double this time. . . . The result of all this disregard of fundamental principles was a series of strikes, followed by the downfall of the men who attempted to make the change, and by a return to conditions throughout the establishment far worse than those which existed before the effort was made." Ibid., pp. 131, 133, 134.

6 American Paper and Pulp Association, 122 East 42nd Street, New York 17, N. Y.

National Paper Trade Association of the United States, Inc., 220 East 42nd Street, New York 17, N. Y.

American Pulp and Paper Mill Superintendents Association, Inc., 220 East 42nd Street, New York 17, N. Y.

Technical Association of the Pulp and Paper Industry, 122 East 42nd Street, New York 17, N. Y.

Institute of Paper Chemistry, Appleton, Wis.

University of Maine, Orono, Maine; Syracuse University, Syracuse, N. Y.; McGill University, Montreal, Canada; Lawrence College, Appleton, Wis.

Forest Products Laboratory, Forest Service, United States Department of Agriculture, Madison, Wis.; Pulp and Paper Research Institute of Canada, supported by Department of Mines and Resources of Canada, Canadian Pulp and Paper Association, and McGill University, 3420 University Street, Montreal 2, Canada.

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7 "Practical Treatise on the Manufacture of Paper in All Its Branches," by Carl Hofmann, Henry Carey Baird, Industrial Publisher, 406 Walnut Street, Philadelphia, Pa., 1873.

8 "Some Methods for the Study of Beating," by A. B. Green, *Paper*, vol. 17, Feb. 23, 1916, pp. 21–22, 24, 26 and 28.

"Viscosity Principle in Beating," by A. B. Green, *Paper*, vol. 21, Oct. 24, 1917, pp. 17, 34.

Training for Transition to PROFESSIONAL RESPONSIBILITY

(*Continued from page 636*)

during these practice sessions. In this respect alone this training program may easily pay for itself whenever it is given. We are indebted to the Training Within Industry Foundation for the methods, and to Michael J. Kane, trustee of the Foundation, for introducing us to them.

Besides speaking and writing, the engineer is also called upon to read. Professional men who read a great deal of relatively difficult technical material tend to acquire reading techniques that persist when they read easier material, such as may be found in correspondence, popular journals, and the like. For this reason, it often takes just as long to read the easy material as the difficult. At least the Air Forces diagnose the problem this way, for they have set up very extensive reading-rate-improvement laboratories for their military and professional personnel at Maxwell Field, the Pentagon, and at the National War College. The successes claimed for such training are, to say the least, very encouraging. The U. S. Navy Bureau of Ships and the Marine Corps have run similar programs on a trial basis, and the Naval Ordnance Laboratory is currently taking steps to make such training available to its own scientists and engineers.

When one considers the volume of administrative and "general information" reading matter with which an engineer's desk is often plagued, such a course might likewise pay for itself in time saved alone.

MANAGEMENT RESPONSIBILITY

This paper has dealt exclusively with some of the technical and human factors we believe are involved in an engineer's transition to *professional responsibility* in a large research and development laboratory. When he is promoted to a supervisory position he immediately assumes the administrative duties necessary to getting things done *through his people*. This is a major step in his career. Many of the skills and attitudes he had successfully developed on the lower levels must be relinquished in favor of the young engineer coming up the line. He must, for example, try to infuse in his subordinates the very "inclination to do one's own drafting" that he must resist in himself. He must similarly hold himself in check lest he devise all the test procedures involved in a given problem and lest he thereby stultify the development of the engineers working for him. This kind of self-discipline comes very hard to even some of the most competent engineers, but it can be learned. Many engineers effectively kill their chances for being assigned to progressively greater management responsibilities because of their temperamental incompatibility with the supervisory role. But this problem is one of transition to *management* rather than to *professional* responsibility and so will not be discussed further here.

In summary, training for transition to professional responsibility must be a joint effort between public and private employers on the one hand and educational institutions on the other. I believe we have demonstrated that such co-operation can be very close and profitable. It is most effective when the college staffs are sufficiently employer-oriented, and the company staffs are sufficiently aware of the value of organized in-service training as a basic management tool. We are fortunate that at the University of Maryland and at NOL both these conditions exist.

RAILWAY ROLLING STOCK

A Vital Problem in Materials Handling

By ALFRED E. PERLMAN

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THE importance of railway rolling stock in our transportation industry is clearly evidenced by the fact that more than 50 per cent of the total operating costs of U. S. railways today are directly or indirectly affected by the nature and manner in which this equipment is used. Fuller utilization of equipment will go hand in hand with lower operating costs, lower capital expenditure, increased safety, and better service.

To attain these goals, railway mechanical-engineering officers are in a key position to establish current cost and performance controls and make greater use of our expanding science.

For example, one third of the total investment in railway plant is accounted for by locomotives and cars. Class I Railroads have $2.5 billion invested in locomotives and more than $5 billion in cars. Only three hours of the average freight car's day are spent in over-the-road movement manufacturing ton miles, while 21 hours are spent in terminal detention. Just by adding four minutes per day to each car's over-the-road movement, our car inventory can be increased by $100 million.

SOLVING THE HANDLING PROBLEMS

To achieve maximum utilization, certain of the handling problems must be solved by the engineering department, others by the transportation department, but the major solutions rest with the railway mechanical engineer.

The engineering department's function is to furnish a modern plant facility through which rolling stock can be moved expeditiously. In the past few years railroads have spent hundreds of millions of dollars in improvments such as stabilizing the subgrade, placing additional ballast and heavier rail to give a better track structure, eliminating curves and reducing grades, installing centralized traffic control and radio communicating systems, electrical operating switches in and out of yards, redesigning yards to accommodate the longer trains now being run, and installing hump yards with car retarders for more expeditious switching.

The transportation department, which is charged with the movement of railway rolling stock, is governed in its use of equipment by shippers' requirements. This department, therefore, must work closely with shippers to insure prompt loading and unloading of cars, as well as the loading of maximum tonnage within the cars.

The transportation department must also have such records and procedures to insure that there is no unnecessary crosshaul of equipment, that the type of power both for road and helper movement is used on subdivisions on its line which will permit the maximum tonnage being handled consistent with schedule and operating requirements. It must also dispatch the trains to secure the optimum utilization of both road and helper power. Expedited switching in terminals and controls to insure prompt spotting of cars at industries and the prompt removal of empties are required.

While the engineering and transportation departments have a marked influence upon efficient handling of rolling stock, the activities of the mechanical department have a direct bearing upon the activities of the other two departments. For example, a change in the design of rolling stock can affect clearances, required bridge ratings, rail section, length of yard tracks and sidings, enginehouse facilities, fuel and water stations, and other characteristics of the physical plant.

Expeditious handling by the transportation department is also vitally affected by the type and quality of the rolling stock. Therefore, proper locomotive and car design must not only embody the most recent technical advances, but the mechanical officer must have a wide knowledge of service requirements and the limitations of the physical plant. He must know the limitations of the suppliers' facilities and have a background in rolling-stock maintenance so that running repairs can be made promptly and economically.

It is important that the mechanical officer have liaison with the shipping public, other departments of the railway, equipment suppliers, and technical experts. This will insure the railway of the type and quality of rolling stock which will permit the greatest availability and thereby the fullest utilization.

However, two matters should be stressed. First is the need for adequate current cost and performance controls. Second is the need for even greater fundamental research on the part of the railway industry than exists today.

COST AND PERFORMANCE CONTROLS NECESSARY

Because railroad accounting departments are set up with their main objective to keep accounts as prescribed by the Interstate Commerce Commission, their functions have turned primarily to bookkeeping rather than cost keeping. Therefore, data which are received by supervisors ordinarily come late the following month. They are then ancient history. Rather than being able to correct out-of-line conditions currently, we get alibis for poor performance or for man power and materials which are irretrievably lost.

In order to expedite their work, accounting officers tend to keep their accounts in a manner which will enable them to most readily close their books rather than permit derivation of controlling unit costs.

Normally, therefore, it is mandatory that a supervisor establish his own controls to give him current indexes of performance and cost covering the work under his own jurisdiction.

Thus every supervisor must be made cost and performance-conscious. Statistics which come to the general officers near the end of the following month will not accomplish this. The men on the firing line already will have used up the material, delayed the turning of power, wasted car-days, or had too many employees working.

But if every supervisor keeps some daily reports of unit costs and performance of the work under his jurisdiction, and periodic comparisons can be made of these records, line officers are quickly stimulated to better quality of output. The techniques of the supervisors obtaining the best results quickly can be adopted by the rest of the system.

The general officer who is in possession of such unit costs can

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not only rate his men, but he can compare the total operations of his department with those of other railroads.

MORE FUNDAMENTAL RESEARCH NEEDED

Having these current controls and using them with ability and ingenuity, we can then examine facts and processes critically and creatively, that is, we can become research-conscious!

In the 85 years that railway mechanical engineers were responsible for the design of motive power, less progress was made than in the past 15 years—when an organization entirely alien to the railroad field, with a competent research staff and open-minded personnel, entirely revolutionized the field of railway motive power. They not only successfully used a new prime mover, but they pioneered in standardization of parts, in economic studies to determine the necessity for new power, and in schools to train personnel who were to operate and maintain the power.

The result has been that in the past two years, using the same horsepower in the Diesel engine, we are taking nearly twice the tonnage over our ruling grades because of research in better insulating materials for motors and generators! This has had the same effect as if we had spent hundreds of millions of dollars in reducing our mountain grades from a two per cent to a little over one per cent maximum!

However, the situation still exists where the railway mechanical engineer is responsible for the design of passenger and freight cars. With but few exceptions every order of cars is tailor-made to suit the purchaser even though these cars may be used on other railroads a greater part of the time than on the owning line. Because one designer believes that a washroom should be in one corner of the passenger car and another designer thinks it should be in the opposite corner, the entire structure of the car must be built to order.

The AAR has finally adopted a standard design for a welded boxcar. Yet where welding has been used it is apparent that full knowledge as to stresses set up in the structure has not been obtained. Some of the highly specialized parts such as underframes, when welded, are found to develop failures because basic welding research has not been properly utilized.

FURTHER STANDARDIZATION ESSENTIAL

While one manufacturer is leading the fight to standardize the boxcar in the same manner that the locomotive builders are standardizing Diesels, the railroad industry, in general, is not co-operating. They argue that standardization would freeze design and vitiate progress.

Each railroad still requires the signal companies to have separate patterns for their own use, just as the railway mechanical engineers still demand custom-built cars. This is a far cry from the philosophy of finding the best materials and methods and concentrating upon them. As a result the railroads are paying in increased costs and inferior products!

Mechanical-engineering studies have developed and are continuing to develop new types of motive power and passenger and freight cars. But in the past as well as the present, railway mechanical engineers have not utilized all the available facilities for critically reviewing and expanding the new scientific techniques so that they could apply them to the operating conditions imposed by railroad service.

What has been done in the past 25 years to reduce the weight of freight cars in step with increased scientific data on stress analyses and lightweight alloys?

Why do we continue the program of installing "AB" brakes on cars when we know they should have long been declared obsolete in order to permit further weight reduction on our freight cars?

Why can't we help the physical plant by reducing the center of gravity of cars? This would eliminate the necessity of many costly line changes made to reduce curvature in order to speed up traffic. The low-slung automobile can go around a sharp curve more safely and comfortably than can our modern (?) freight and passenger cars.

We still pay a premium for patent design on cars which make certain claims for increasing strength or saving weight with blind belief in the patentee's statements. Yet there are techniques in stress analyses today which could quickly give proof of their validity.

Diesel locomotives are rapidly replacing steam. Yet for the most part, basic research on the new motive power is being done only by the manufacturer.

This is an easy way out for the railroads, but they are paying for it in many ways. For with all the fine research and testing being done by the manufacturers, a thorough knowledge of operating requirements and service stresses cannot be obtained without a basic knowledge of railroad operating conditions. If the railroad industry had a group of scientists with a background in railroad operating conditions who can co-operate with the manufacturers, many faults could be removed from the apparatus before it is placed in service.

An engine or apparatus which might prove almost perfect in a stationary power plant or in a test rack might show entirely different characteristics when faced with actual railroad operating conditions. This has been brought out in the problems which have arisen in the field of fuel and lubrication.

It was found in many cases that broken piston rings were directly attributable to the type of Diesel fuel being used. One railroad, which does have a research laboratory, found that the type of oil being used by one of the locomotive builders to break in the engines caused wear on the engine equivalent to that obtained after being run 100,000 miles in railway service.

That same laboratory found that proper lubricating oils could be used indefinitely in Diesel engines; that new oil had an affinity for metal which caused accelerated wear compared to using the old oil. When a locomotive on that railroad goes in for overhauling after perhaps 300,000 miles of use, the oil is drained, reclaimed, and re-used in another locomotive. Yet some of the manufacturers recommend that the oil be changed at the end of 15,000 miles, and one railroad boasted that it was obtaining 30,000 miles between oil changes.

Much of the lack of standardization can be attributed to the fact that while committees meet to discuss the best methods and materials to be used, little scientific research has been done to back up their arguments.

In an industry as large as the railroads, a pitifully small sum is being spent for basic scientific research. There are many problems in which fundamental research is required and in which the railroad industry could be helpful to itself and to the suppliers of equipment.

PROBLEMS REQUIRING BASIC RESEARCH

One of the most important problems now requiring attention is the subject of steel wheels in Diesel and high-speed train service. Design and metallurgical research into the solution of the wear and thermal failure problem of steel wheels never has been fully explored.

Too much has been left to opinions of controversial groups. Differences of opinion, while necessary for a critical review, should not deter nor prevent a full study of all factors so that an ultimate solution of these problems, which have been with us since the introduction of the steel wheel, may be secured.

Certainly, methods are available for studying the design problems, the stresses induced in the wheel by manufacturing operations and their change due to the heating from the break-

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ENGINEERING *in* FINLAND

By PEKKA MANNIO[1]

THERE are about 4000 engineers in Finland, or one out of 1000 in relation to the total population. Nearly all Finnish engineers are graduated from the Finland Institute of Technology of the University of Helsinki. This is actually the only technical university in the country. The FIT recently held its centennial celebration and is recognized both academically and scientifically as being on an equal plane with other Scandinavian technical institutes. Students graduate from the FIT after five years with the title or professional degree of "Dipl. ins." This is comparable to a master of science degree received by engineering students in the United States.

Courses at the FIT are offered in civil, agricultural, mechanical, electrical, chemical, and surveying engineering; wood technology, architecture, and technical physics. Students at present number about 2000. This is exceptionally high, the normal being 1500, with 300 graduating yearly.

The two main Finnish industries, metals engineering and woodworking, started in the seventeenth and eighteenth centuries, respectively, but their real industrial development coincided with the growth of the engineering profession during this century. For example, in the 1920's there was a tremendous upswing in technical advances and production capacity of the woodworking industries. Products from these industries—sawmilling, pulp, paper, and cardboard—constituted 85 to 90 per cent of Finland's exports.

The 1930's again saw a significant increase in the volume of the so-called home-market industries, namely, mining, metals engineering, textiles, glass, cement, leather, and food. Meanwhile, the woodworking industries, because of limited forest resources, turned more to the production of finished articles.

During the last decade, Finland's industrial structure has become still further diversified. The woodworking industries, due to heavy plant and forest losses and land cessations to the USSR, have further developed such products as prefabricated-house construction, fiberboard, and rayon.

There also has been great activity in the metals-engineering industries. In base metals, Finland is self-supporting and even exports copper. Iron ore, however, is imported from Sweden and about 60 per cent of the rolled-steel plate used is also imported.

The lack of many other raw materials, howover, is balanced by some favorable aspects. For example, the Finnish forest industries constitute a large and efficient experimental field for woodworking-machinery design and construction. The labor force, on the other hand, seems well adapted for precision work, such as in the field of mechanical instruments.

Besides manufacturing, other engineering problems which face Finland are power development, transportation, agricultural mechanization, and lower-cost housing.

Because of the low water head, Finland's hydroelectric power construction is costly, perhaps twice that of Sweden's and five to ten times that of Norway's. Industrial demands and the rural electrification program are now being met by the supply, but a considerable portion is generated in steam plants using imported coal. It is therefore necessary to continue the building of hydro plants. Present capacity is about 3500 million kwhr, and by 1954, with the hydro construction program now in effect, a capacity of 5400 million kwhr is expected.

In the transportation field, truck haulage is gradually replacing waterway logging of wood from the forests because of the high labor costs. For this same reason materials-handling devices are urgently needed for both in-plant and outside transportation. Dock-handling facilities are especially necessary. Highway trucking is gaining freight volume from the state-owned railroads and would gain still more if the road system were adequate. At present, out of a total of 20,000 miles of roadways, less than 100 miles are paved.

Agricultural mechanization is encountering difficulties because of the soil and landowning conditions. Topographically and traditionally Finland is a small-farm country. The resettling of more than 300,000 Carelian DP's (nearly 10 per cent of Finland's population) resulted in even smaller farm sizes. This meant a considerable decrease in the purchasing power and investment capacity of farmers. The inherent conservative attitude of rural population toward rapid changes is a further obstacle.

Housing construction costs have always been fairly high because of the severe climate. Building activity during and after the war was restricted, and, in addition, rent controls made construction unprofitable. A five-year government-subsidized housing program, therefore, has been started to ease the tremendous housing shortage (70,000 units), to partially fill the gap. The principal work, however, lies in the field of engineering. For example, the prefabrication of houses already is a well-developed industry, but production is mostly exported as the domestic cost of on-the-site building is about the same. Standardization of many building components is well under way, but the mechanization of construction work is underdeveloped.

To meet the challenge of these new developments, there must be more advanced study, training, and research. Such opportunities are offered in the FIT, the State Institute for Technical Research, and in professional engineering societies.

On the student level, Finland is a member of the International Association for Exchange of Students for Technical Experience (IAESTE). This year the Association's activities will include exchanges with the United States. However, important as this is, professional development requires that more mature engineers visit foreign countries for periods of 3 to 12 months. For example, there is much to learn from U. S. industries in machine design, tooling, materials handling, chemical engineering, production engineering, time study, and the like.

Finnish engineers, therefore, have received with great interest the information concerning passage of Public Law 265 of the 80th Congress of the U. S., which provides dollar funds through Finnish war-debt payments to be used for cultural and technical exchange purposes between the United States and Finland.

Industrial and technical field work would undoubtedly be the best method of studying American engineering know-how. Actual inspection of factories, laboratories, and research institutes would be extremely beneficial to visiting engineers. Acquiring traineeships in United States industries for younger engineers would also be helpful.

The Finnish engineering profession eagerly looks forward to this worth-while exchange program and meeting with American industry and engineers.

[1] Manager, Technical Department, Federation of Finnish Industries; Secretary, Finnish Management Council; and Treasurer, The Finnish-American Society (commercial), Helsinki, Finland. Jun. ASME.

TECHNOLOGICAL CHANGE[1]

By GILBERT K. KRULEE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

EVERY society must solve the problem of providing for its continuing physical existence. Provisions must be made for supplying food, water, shelter, and clothing to the members of the society. The solutions followed by a particular society will reflect in part requirements imposed upon it by the environmental setting in which the society finds itself, for a society must adapt to those specific problems that the physical environment imposes upon it, and the particular methods of adaptation that it will select are limited by the environmental resources that can be made available to it.

In some societies physical existence is provided for by traditional and relatively unchanging methods. We could describe such a society as possessing fixed solutions to its economic problems or as characterized by an absence of technological change. The society in which we live cannot be characterized in such a fashion. Our physical existence is based upon a highly complex pattern of industrial organization and upon the availability of people who possess the skills and knowledge which are required for the operation of this level of industrialization. Moreover, as Fritz Roethlisberger recently pointed out, "Modern industry is no longer turning out customary products in customary ways for customary markets. It is committed to the turning out of new and different products in more efficient ways at lower cost for more quality and price-conscious consumers." It is this continual "turning out of new and different products" that characterizes our society as one of continual technological change.

The assumption is generally made that technological change is "a good thing" for the society as a whole. In fact, for most of us technological change is synonymous with economic progress: the long-run consequences of technological improvements have generally been an increased standard of living and an increase in the total physical wealth of the society. Yet for those individuals most directly affected by such changes it is not always true that change is other than tragic even in the long run. In this respect, I am referring to workers whose skills and knowledge may be rendered obsolete and who will be forced to learn new skills and adapt to new situations before either their social or economic well-being can be restored to the level existing before the technological change.

There has recently been published by the Yale Labor and Management Center a study[2] entitled "Steeltown, An Industrial Case History of the Conflict Between Progress and Security." This is the first of a three-volume study describing the impact of a recent major technological change on the life of a small community and the steps taken by the members of this community to adapt to these changing circumstances.

Ellwood City is a town of about 14,000 population. It is located about 40 miles northwest of Pittsburgh and like so many other towns in western Pennsylvania is dependent upon the production and fabrication of iron and steel for its economic life. The history of Ellwood City has been tied closely to the development of methods for the manufacture of seamless tubing. Moreover, the prosperity of the town has largely depended on the life of one company, the National Tube Company, which operates a seamless-tube mill employing 4000 people. Two thirds of all employed workers in this community were regularly employed by this one concern. National Tube also operates tube mills in Gary, Ind., and in Lorain, Ohio. Production of tubing in Ellwood City has been based upon the rotary piercing process for making seamless tubing. In recent years National Tube engineers have been experimenting with an automatic and continuous process for making tube which would make the methods followed at the Ellwood plant obsolete. Recently these methods were ready to be applied and in August, 1946, the decision was made by National Tube and U. S. Steel officials—for National Tube is a subsidiary of U. S. Steel—to install the new process in the Gary and Lorain plants and over a period of three or more years to move all operations out of Ellwood City.

The logic of the officials who made this decision was clearly the logic of economics. The company faced two problems, that of modernizing its methods for producing tube in order to maintain its competitive position, and also that of deciding where to locate a plant or plants which would utilize these improved methods. Unfortunately, from Ellwood City's point of view, the Ellwood equipment was both obsolete as well as being poorly located in terms of geographic considerations. Both Gary and Lorain are more strategically located with respect to basic steel facilities which supply the raw materials for the manufacture of tubing and with respect to the markets in which the finished product can be sold.

However, coincident with the announcement of the impending move to Gary and Lorain, National Tube officials promised that all displaced employees from the Ellwood plant would be offered employment in either Gary or Lorain. They also promised that the company would co-operate with the United Steelworkers of American, the union which represented for collective-bargaining purposes the employees of all three plants, in trying to work out solutions to the problems of retraining the displaced workers, moving their families to a new home, and devising a system for transferring seniority that had been earned in service at Ellwood to the other plants.

For both the employees of the Ellwood plant as well as the community as a whole, there were two courses of action open to them. "Clearly, in theoretical terms at least, there are two answers or alternative solutions to the problem of change: (1) to prevent or forestall the change altogether, (2) to adapt human behavior and/or the forms of a particular culture so as to preserve its values in the midst of a change." To some extent both courses of action have been followed. The local union as well as other segments of the community have attempted to question the wisdom of the move to Gary and Lorain and to influence the company to reconsider its decision. The result of this course of action seems to have been that gradually the community has gathered enough information from both the company as well as other sources so that they have begun to recognize the inevitability of the move. However, for the time being at least, the demand for the products manufactured at Ellwood City has been so great that the company has temporarily postponed the actual move until this

(*Continued on page 646*)

[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "Steeltown," by Charles R. Walker, Harper and Brothers, New York, N. Y., 1950.

Appraising RETURNS *From* RESEARCH[1]

By ALLEN ABRAMS

VICE-PRESIDENT, MARATHON CORPORATION, ROTHSCHILD, WIS.

RESEARCH has now come of age and is a generally recognized and accepted function of industrial enterprise. Yet, in spite of its rapid rise during recent years, there is still considerable room for expansion. Take a look at the roster of blue chips on the New York Stock Exchange. Of the companies there listed and who might employ research, approximately 65 per cent have such departments. In many individual industries the proportion is decidedly lower, and the research share of the sales dollar is correspondingly smaller. Might it be possible that research would make greater strides if it could prove itself more adequately through the operating statement and the balance sheet?

While research cost usually represents a small part of company expense, yet management is kept ever conscious of the money being poured into the department, but has no adequate gage of what flows out of the department. Executives would like a fair measure of the value of their research, and many research directors might have fewer ulcers if they had some basis for learning how well they were doing. Yet it may be expecting too much to believe that satisfactory methods can be developed for evaluating this function of the business. Literature on the subject is scant, most of it issuing from work carried on by members of the Industrial Research Institute. These studies have indicated the need for such an appraisal and have suggested some methods for carrying it out.

In our own recent survey we canvassed all members and a few nonmembers of the Industrial Research Institute as to whether they had any system of appraising their work. About 85 per cent of the members replied, and there was a wide expression of interest in the subject. Only 25 per cent of the respondents had any pertinent answers, indicating that many directors have not considered the subject or else have felt it difficult or unnecessary to attempt any justification, particularly of a concrete nature.

When research has been long-established in a company, the value is usually so well accepted that no formal justification is required. This is particularly true if the head of the company is technically trained or appreciative of technology; and if he lends guidance in the program and in translating the results of research into production and sales. However, there have been many cases where the department has failed through management's lack of understanding as to the functions and relation of research to the company's business and as to the results which have come out of research.

JUSTIFICATION OF RESEARCH

In our current study a number of directors have indicated that the effectiveness of research can be judged best by the general health of the company. Some justify research on the basis that it keeps them abreast of competition and that otherwise they might not be in business at all. Like Alice in Wonderland it is increasingly necessary to run faster just to stand still. Yet one corporation expresses enough confidence in its research group that it speaks of selling a product first and then hopes to develop and manufacture it afterward.

A number of companies have worked out formal procedures for crediting research. As a preliminary, they have pointed out the difficulties of such an appraisal and have cautioned research not to claim undue credit. Generally these companies feel that this evaluation can be accomplished best by having representatives from sales, production, accounting, and research sit in on the final appraisal.

The actual procedures vary widely in their approach to the problem. One company simply adds a certain amount to the cost of each article produced through research and then credits this "royalty" to the department. A large chemical company selects a committee from research, production, and sales to determine the contribution of research on a new product or on the improvement of an old one. Where research has been responsible for most of the original ideas and their development, all future sales on that particular product are credited to the department. Where research is but partially responsible, only a proper share of the sales is credited. If a major improvement is made on an old process, the higher yield or greater volume accrues to the research department.

Another company has evolved a more extensive method for appraising these results—perhaps the most detailed and precise of any we have investigated. A proposal on a new process is submitted to the factory manager by the research and development division. If the manager accepts the idea, any savings resulting from its adoption are ascertained by the accounting department and are allocated to research. The "Index of Return" is the sum of three numbers—savings for one year on an improved process; 3 per cent of the net sales on an improved product, for a period of one year; 3 per cent of the net sales on a new product, for a period of three years. This index is said to measure not only the effectiveness of research but also the ability of the factory to accept new ideas and of the sales department to sell new or improved products.

A large oil company evaluates its research every five years. The benefits are considered to come from (1) elimination of royalty payments, which are said to be easy to estimate; (2) benefits due to improvement in existing processes and products, resulting in added capacity and thereby representing a saving in investment and a reduction in operating cost. Another advantage lies in the increased business brought about through improvement of quality; (3) additional profits from new products.

A lumber company uses another method: (1) Where the commercial value of research results can be estimated, credit is taken for the direct savings in cost and increased profit on any product. (2) Where positive well-defined action has been taken on the discoveries of research but where the actual dollar value cannot be calculated, it is assumed that the project is worth 4 times the cost of the research. (3) Where re-

[1] Paper presented at the Annual Meeting of Industrial Research Institute, Rye, N. Y., April 26–28, 1950.

search has produced information of potential value for improving operations or where research has carried out surveys and studies for other divisions of the company, it is assumed that the resultant value is twice the cost of the research. (4) Miscellaneous services are valued at cost. No credit is given to projects which have failed to produce tangible results, even though they may have some future value.

A second oil company has a rather extensive procedure. On new and improved products, credit is given to research for the total profit in the best year of a five-year period immediately following the initial marketing of the product. On new manufacturing processes the profit is credited to research for a period of one year. On improved manufacturing processes, savings in cost are taken for a period of one year. On patents acquired through research, all royalties or sales of the patents are credited to the department.

A paper company employs a different approach. The annual sales and profits are totaled separately for research and nonresearch products. The net profit on research products is then compared with that of nonresearch or standard products, and the increment only is credited to research. This increment is then divided by the cost of research for the year, yielding a quotient showing the dollars returned per dollar expended for research. No credit is taken presently for process or product improvement nor for royalties on patents acquired through research. The obvious question is as to how long credit should be taken for profits from such research products. Generally this is self-answering, since other manufacturers come in with competitive products which may reduce profits to the point where the research products become "standard."

RETURNS FROM RESEARCH EXPENDITURES

The actual yield from research expenditures varies widely, due in considerable degree to the effectiveness of the research department in developing and pushing its wares. Probably even more important is the difference in the formulas used for obtaining the answer. For example, one group indicated that its credits were about equal to its expenditures. As this is a very successful company, it seems unlikely that the formula is predicting the proper earnings. Likewise, over a period of seven years, a prosperous oil company showed annual results ranging from a profit of $1.45 to a loss of $0.25 on each research dollar. The seven-year average showed a profit of $1.35 per dollar expended. In one particular year a paper company had a net return of $12 for each research dollar used in producing that figure. Another company estimated a yield of $15.40 for each dollar of research expense. This amount was composed of $3.70 for savings in royalties which would otherwise have been paid to outside groups; $9.60 for profits realized through process and product improvement; $2.10 for profits from new products.

The significance of these figures is appreciated by considering the fact that a company is thought to be prosperous if it shows a profit of $0.20 for each dollar expended in producing that profit. However, it must not be assumed that these are typical of all industrial-research earnings. Nor must it be forgotten that in predicting the results of research the law of diminishing returns holds good, otherwise there would be only a celestial limit on its expenditures. Let it be remembered also that there are other less tangible benefits accruing from research and which do not necessarily show in these figures.

SUGGESTED EVALUATION METHODS

For those companies which are interested in working out a system of evaluation, the following suggestions may apply: Select a committee representing sales, production, accounting, and research. Agree upon a formula which assigns to research a fair share of the fruits of its labor. This may comprise some percentage of the sales or profits on new or improved products or processes. Since the amount and period of credit may vary widely, reasonable figures should be agreed upon. Additional accruals to research may come from royalties and the sale of patents. In some cases the credit on a new development is made arbitrarily by assigning an amount which is some fixed multiple of the cost of research. Still another procedure is to select the total profit for the best year out of the five immediately following introduction of the product on the market. Where it is possible to segregate sales, the increment of profit on research products over nonresearch products may offer a fair method of evaluation.

Technological Change

(Continued from page 644)

demand shall begin to decrease. Nevertheless, the new processes have been installed at the Gary and Lorain plants.

In part the community has attempted to adapt to the impact of this change. They have made determined efforts to assist in the development of new and diversified industries in Ellwood City which would help to provide employment for those workers who will be displaced when the plant actually ceases its operations. Some degree of success has resulted from these efforts although there have by no means been enough new employment opportunities created to insure a smooth transition for the community when National Tube's plans are finally put into effect.

As part of the study of how this community has adapted to this challenge, workers in the Ellwood plant were interviewed as to how they felt about moving from Ellwood City. Half of those men interviewed said they would move under no circumstances. Only one third said they might go and most of these only under extreme circumstances. This seems to be symptomatic of the fact that for most employees their thinking is influenced only to a small degree by the economic aspects of the move. They have been upset but not merely because the move may cost them money. They have established themselves in Ellwood City, they have friends, are respected in the community, and both they and their families have been happy in the pattern of living to which they have become accustomed in Ellwood City. Their major concerns are over the problems of re-establishing themselves in a strange community and among strange people. For the workers, it also means that the hard-won skills that they now possess and upon which their status as members of the Ellwood community depends are being devalued. They must start over again in attempting to learn new skills if they are to re-establish themselves and their sense of security. Moreover, what will happen in Gary or Lorain is unknown and they have little information for anticipating what they would face in this strange community.

In general, the significance of this study is that it poses an important problem of technological change. Technological knowledge is useful for a society only if members of the society can be organized to work together in terms of that knowledge. The experience of Ellwood City indicates that our society has not yet devised very good methods for the smooth and efficient introduction of technological change. However, if technological change is to lead to industrial and social progress, methods must be found for bringing about necessary changes with a minimum of disruption in the lives of the individuals and the communities affected, and for securing the co-operation of those individuals who must use new developments in technological knowledge.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

Compiled and Edited by J. J. Jaklitsch, Jr.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Engineering Schools

IN June of this year approximately 51,000 men and women received degrees in engineering and science from more than 150 U. S. technical schools. This is a far cry from 1835, when Rensselaer Polytechnic Institute granted the first nonmilitary engineering degrees in the United States, it is pointed out in the *Industrial Bulletin* of Arthur D. Little, Inc., for June, 1950. According to the *Bulletin*, by 1866 there were six recognized technical schools, but a total of only 300 men had been graduated.

The early engineering schools had a difficult task in combating the general public feeling that engineering education was inferior to classical studies. Although Rensselaer had actually been founded in 1824 and offered systematic courses of laboratory instruction, it was 11 years before degrees were granted. West Point, opened in 1802, is sometimes considered the first engineering school in this country, but its program stressed military engineering, rather than the "civil" branches. It was not until 1845 that the first school of engineering was established as a branch of a classical college at Union College, and only two or three men were graduated each year until 1860.

In the United States the growth in higher technical education coincided with the industrial revolution, but advanced technical schools had been founded in France and Germany somewhat earlier. The École des Ponts et Chaussées was started in 1747 and was soon followed by the École des Mines. Another early school of mines was that of Freiberg, in Saxony, established in 1826. Two years earlier, Liebig started in Germany what was perhaps the first chemical laboratory to which students were admitted. Some of the early trade schools in Germany and Bohemia later developed into engineering colleges of high rank.

After the Civil War the increase in technical schools became one of the phenomena of American education. One factor in this expansion was the Morrill Land Grant Act, which specified that the colleges so aided should teach "such branches of learning as are related to agriculture and the mechanic arts." Nevertheless, a substantial percentage of American engineers and chemists continued to be trained abroad. It was not until Johns Hopkins was founded in 1876 that the United States had a school patterned on the German model, with scholarship the primary criterion for the staff, lectures and seminars the basic teaching procedure, and training directed toward producing men capable of doing pioneer research.

At a relatively early stage, the engineering curriculum crystallized into its present pattern, withstanding attempts to make courses more specialized and tied to specific processes and practices. As early as 1852, Rensselaer had developed the educational philosophy and curriculum which has become the pattern for modern colleges of engineering. By 1870 courses at Stevens Institute of Technology were planned on a broad foundation of mathematics, literature, and the physical sciences for the first two years, with professional studies, laboratory courses, and shopwork in the last two years.

As the United States grew away from dependence on European products, and as commerce and industry became more competitive, the need for trained engineers grew tremendously. The haphazard characteristics of earlier industrial efforts gave way to skillfully engineered enterprises which helped the growth of an industrialized nation. This parallel growth of industry and the engineering profession has today reached the point where engineering is the leading profession for men, with over 375,000 practitioners, and it is still the fastest growing.

UHF Television Transmitter

A NEW type of transmitter that will aid in opening additional air lanes for television has been announced by Stanford Research Institute, Stanford, Calif.

The transmitter has been designed for sending signals in the ultrahigh-frequency (UHF) region of 475 to 890 megacycles recently authorized by the Federal Communications Commission for experimental television broadcasts.

The new transmitter was developed under the sponsorship of John H. Poole of Long Beach, Calif., and is adapted to the needs of his experimental UHF station KM2XAZ at Long Beach.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources, i.e.: (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

Now installed, the transmitter operates on 530 megacycles. It radiates an entirely standard amplitude-modulated picture signal of good quality and, it is claimed, does so in a manner permitting the attainment of a very high-powered UHF transmission more economically than by any other presently known system.

While the KM2XAZ transmitter is at present radiating only 150 watts of power, it is capable of being amplified to powers in the tens of kilowatts using relatively simple radio-frequency amplifiers. This is achieved by applying for the first time to television a system of modulation known as "phase to amplitude."

The phase-to-amplitude modulation system reaches high power levels with presently available UHF tubes which are difficult to amplitude-modulate by any other means. The special transmitter can also make use of the recently developed "unorthodox" tubes such as klystrons, resnatrons, and traveling-wave tubes.

The heart of a transmitter of the new type is the phase-modulator unit, which serves to advance the phase of one of the two signal channels of the system by exactly the same amount that it retards the phase of the second channel. A unique arrangement of conventional UHF tubes has been employed to perform this function satisfactorily.

Still another innovation in the Institute's work on the transmitter has been the development of a vacuum tube which does the modulation job of several conventional tubes in one. Several models of the special phase-modulator tube have been built and tested. Thus far these tubes have had the limitation of low power output. If they can be developed to the point of operation at higher power levels, staff engineers believe the complexity of the phase-modulator unit can be greatly reduced at the same time its performance is improved.

Perfection of a transmitter of the type announced has been one long-sought step toward the opening of the UHF region for commercial broadcasting. Another is the development of converters for bringing UHF signals down to the VHF (very high frequency) level of standard commercial receivers. Last year such a prototype converter was designed and built at Stanford Research Institute under Mr. Poole's sponsorship. It employed novel circuit techniques that have attracted widespread industry attention. The converter has since been modified to include several tunable versions.

Since the war, some five million TV receivers have been manufactured and sold in the United States alone. More than 100 stations are now serving these receivers and these are distributed by the FCC over the 12 VHF channels presently assigned for commercial broadcasting.

Stations which are widely separated geographically can operate satisfactorily on the same channel because of the inherently short transmission range of the high radio frequencies used for television. But because even the best receivers have trouble clearly differentiating between two stations on immediately adjacent channels, the maximum practical number of stations which can be received well in any given area is seven. This limit has been reached in New York and Los Angeles.

What is even more important, many smaller communities which are too far away from large cities to receive their TV broadcasts are still close enough so that they cannot be assigned a channel because of the interference it would cause in the service area of the city stations.

Trying to fit each new station into this complicated patchwork pattern with only 12 channels available grew to be a large and often impossible job. Late in 1948, when the number of applications for new TV stations had exceeded 300, and more were coming in every week, the FCC—it has the responsibility of assigning frequencies in all portions of the radio spectrum—initiated a "freeze" on these and all future applications and took time out to make a thorough engineering study to see if more TV channels could be made available in the already overcrowded radio spectrum.

This freeze is still in effect. Since a single TV channel occupies six times as much frequency space as is covered by the entire dial range of a standard broadcast receiver, TV stations from the beginning were forced to use the very high frequencies which previously have been considered impractical for radio communication. At present five TV channels are in the frequency range 54 to 88 megacycles and seven are in the range 174 to 216 megacycles.

The next group of frequencies which might be available for more TV channels lies in the UHF region of 475 to 890 megacycles, about four times as high as the present "high" band. Use of the new region would provide about 40 more channels for distribution. During the past 18 months electrical engineers at Stanford Research Institute have been exploring possibilities of this region in the laboratory. The new transmitter and the earlier converter are two promising contributions they have turned up.

Conveyerized Dairy

WHILE engineering and milking dairy cows may not seem related, engineering methods have provided an Iowa dairyman with an ingenious milking system in so far as large-scale milking of cows is concerned, according to Clay Colley, Mem. ASME, and a consulting engineer in Los Angeles, Calif.

The dairyman, H. C. Cain, used the same basic principles that are applied when first approaching any materials-handling, work-simplification, or time-study problem. These principles are as follows: (1) Keep the skilled workman at a convenient work station where tools, parts, and products are brought to him; (2) place each job or task at the proper work level; and (3) remove finished task at a uniform rate.

Mr. Colley relates that Mr. Cain has applied the foregoing engineering principles to his milking technique and developed a system which has been in operation at the Hiett Crystal Dairy at Delano, Calif., for more than three years without missing a milking. With the system two milkers handle a herd of approximately 250 cows at a rate of 100 per hr. To make such a system work, of course, requires co-operation of the cow. A handful of grain combined with efficient and gentle treatment has assured this co-operation.

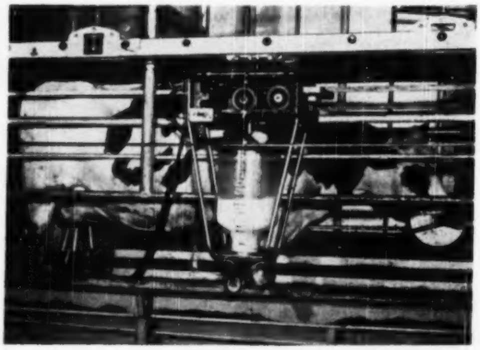


FIG. 1 COW IS SHOWN WITH MILKING MACHINE INSTALLED ON APRON CONVEYER

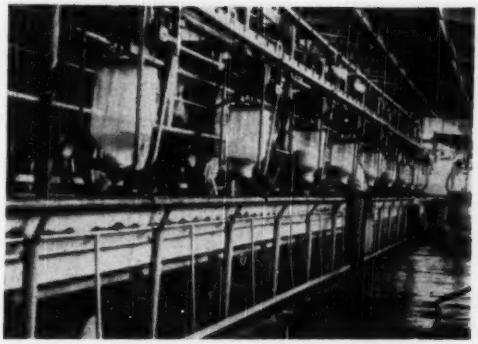


FIG. 2 OVER-ALL VIEW OF APRON CONVEYER

The production line consists of the stock pile, which in this case is an ordinary corral full of cows. For an automatic feeder the usual funnel-shaped outlet is provided and they walk single file into a narrow section where they receive a preliminary wash which consists of an underspray or inverted shower. They are held in this spot for a few seconds by an automatic gate which literally feeds them one at a time on to an apron conveyer.

This main apron conveyer is 22 in. wide, 110 ft long, and is synchronized with an overhead double-chain conveyer which carries the stall ends and feedboxes. When the gate is opened the cow walks into what appears to be a narrow stall with smooth pipe railings forming the sides, a wood floor (which is the apron conveyer), and a feedbox at the end. As she steps up and starts eating, the next stall end folds down in the rear and the cow is now on a slowly moving assembly line traveling at approximately 10 fpm.

At this point she is at the proper height for the milker to give the secondary wash and install the milking cups. The small milking machine with its calibrated glass container is mounted on a third conveyer which travels at the same speed as the apron and stall conveyer. As they approach the discharge end a second milker is watching the line and disconnects the machine, sterilizes the cups, and strips the cow. In case the milking operation is completed before the cow reaches the end of the line, the milker steps down the line, shuts off the machine, and completes the operation when the cow reaches the proper point on the production line.

After the milking machine with its glass container has been disconnected, it travels at a higher speed to the unloading station where it discharges automatically into a stainless-steel receptacle, from which the milk is pumped to the dairy.

When the milking unit is empty it is picked up by a high-speed conveyer which takes it to the starting point. The unit arrives at the proper time to be connected to a cow which has just been placed on the production line.

When the end of the line is reached, an exit gate opens automatically and the cow walks off the end of the apron conveyer.

The following advantages of the system are cited by Mr. Colley:

It saves labor and cuts actual payroll hours; it lightens the burden of the workman, because of the proper work height and assembly-line technique; it provides individual inspection of the milk from each cow as well as a record of her production; and it simplifies taking test samples of the individual milkings at the discharge station.

Minor Metals

ALTHOUGH generally referred to as "minor," a score of little-known metals actually play major roles in twentieth-century civilization, according to James Boyd, Director of the Bureau of Mines, U.S. Department of the Interior.

Beginning with barium and ending with zirconium, the ones in between include beryllium, boron, calcium, cerium, and other rare earth metals, cesium and rubidium, columbium and tantalum, gallium, germanium, hafnium, indium, lithium, rhenium, scandium, selenium and tellurium, strontium, and thallium.

Annual production of these metals and their compounds ranges from a few thousand troy ounces for some to a few thousand tons for zirconium. The average person never sees any of these metals in their pure form. Yet some of them are highly important in the electronics and metallurgical industries, and others, now used only in scientific laboratories, may one day become equally important, Dr. Boyd said.

The production, distribution, uses, and other interesting facts about these little-known minerals are given in a new preprint chapter of the Bureau of Mines Minerals Yearbook.

Some of these metals, notably barium and strontium, are used in the electronics industry for "gettering," which is removing the last traces of gas from an enclosed space, such as a tube. A number of them have been found useful for one purpose or another in the atomic-energy field. Extremely minute quantities of others, introduced into alloys of the better-known metals, such as copper or iron, add strength, resistance to corrosion, heat resistance, or some other property important for a special use.

As examples of the multitude of ways in which these so-called minor metals are used, Dr. Boyd cited watch balance wheels of beryllium-nickel alloy; glass-cutter parts made of boron carbide, hardest known substance except diamonds; cigarette-lighter flints made of cerium; television equipment functioning with the aid of cesium and rubidium; high-grade camera lenses made partly of tantalum oxide; thermometers able to record temperatures up to 1200 C, in which gallium replaces the mercury used in ordinary thermometers; video detector circuits containing germanium diodes; antihistamines in which lithium amide is an active ingredient; antiknock compounds in the production of which rhenium is used as a catalyst; radio and television rectifiers made of selenium; rodent poisons made of thallium sulphate; and flashlight powders made of zirconium.

This list barely scratches the surface, the Bureau Director said, in announcing that the preprint of the "Minor Metals" chapter of the Bureau of Mines Minerals Yearbook, 1948, by Jack W. Clark, Bureau economist, is now on sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C., for 15 cents a copy.

Foreign Ore

THE largest amount of foreign ore ever brought to the United States in a single year arrived during 1949, with receipts from 18 countries, according to *Steel Facts*, a publication of the American Iron and Steel Institute. The largest supplies came from Sweden, Chile, and Canada. Last year also, steel companies were active in exploring and developing large deposits in South America; in exploring the Quebec-Labrador iron range; and in constructing facilities for shipments of ore from Liberia.

These steps toward the eventual widening of ore supply lines have been taken by farsighted steel executives because of the

dwindling supply of high-grade domestic iron ores. The nation's high-grade ores must be supplemented from new sources, particularly while research proceeds toward the economical use of the taconite and low-grade ores abounding in the Lake Superior region.

Last year nearly 8,300,000 net tons of foreign iron ore were brought into this country. That was an increase of 22 per cent from 1948, when imports totaled 6,800,000 net tons. In 1947 about 5,492,000 tons were delivered, and in 1946 the imports totaled 3,085,000 tons.

Developing the new sources of ore in Labrador, the Caribbean, and other areas, and building taconite treatment plants will be costly. Large outlays will be required for research, capital investment, and higher operating costs.

Estimates concerning the capital investment required in the taconite program place the cost at $15 to $20 per ton of annual capacity for producing taconite concentrates. Thus at least 300 million dollars must be invested in order to make 20,000,000 tons of taconite concentrate yearly. If the steel industry were to replace the present Lake Superior natural-ore supply with a taconite supply alone, it would be faced with a capital investment in iron-ore facilities of $1.25 billion to $1.75 billion at today's costs.

In planning a comprehensive iron-ore program, the industry faces the prospect of shrinking domestic reserves of natural ores on the one hand, and the large capital investments and operating costs of developing a foreign ore and a domestic taconite problem on the other.

Five steel and two mining companies have formed a corporation to develop the iron reserves in the Labrador-Quebec concessions. One steel-company executive has estimated that some $300 million will have to be spent before these companies get any of this ore into their blast furnaces.

One steel company has an interest in ore deposits in Liberia. This property must be developed and a 40-mile railroad built from the mine to the port of Monrovia with the cost now estimated at about $8 million.

Of total domestic shipments last year, the Lake Superior district supplied about 81 per cent, the southeastern states 9 per cent, the northeastern states 4 per cent, and the western states 5 per cent. Minnesota produced 67 per cent of the national total.

Steel Tube Mill

A NEW tube mill with an annual capacity of 100,000 tons of electric-welded steel pipe, in sizes ranging from 26 in. to 36 in., started production recently in McKeesport, Pa., at the National Works of U. S. Steel's National Tube Company. Stock for the mill consists of plates from $^1/_4$ in. to $^1/_2$ in. thick. These plates, whose steel composition runs 0.20 to 0.30 per cent carbon and 0.85 to 1.25 per cent manganese, weigh close to two tons each. Standard length is $40^1/_2$ ft while the widths will vary, according to specifications, from $78^1/_4$ to 110 in.

The conversion of plates to tubes is accomplished in 16 big new machines which are the major units of the mill. Ample use of roller conveyers for moving the heavy material from unit to unit makes possible an assembly-line precision of operation. Plate stock is first end-sheared, then side-planed and beveled. After edge-rolling, the first forming operation, the plate is formed into a "U" by a heavy press. Another press further forms the stock into a tube, after which it is welded outside and inside. It then undergoes an inspection before being expanded in a huge hydraulic machine that increases the diameter by actually stretching the steel under water pressures up to 3000 psi. On the initial order, tubes were formed to $29^1/_2$ in. ID and expanded to 30 in. under pressure of 1700 psi. From the expander,

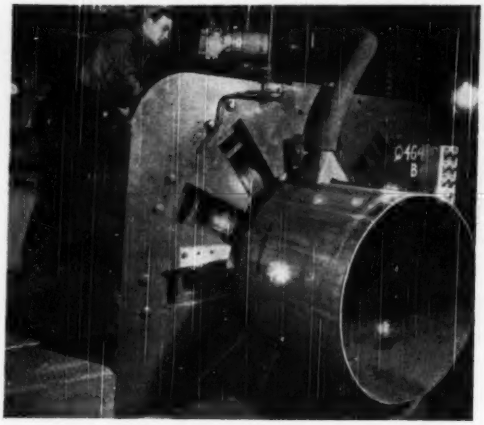


FIG. 3 AN ELECTRIC WELDING MACHINE WELDS OUTSIDE SEAM ON A 30-IN-DIAM STEEL PIPE

tubes are beveled and end-faced. They then receive a final inspection by both company and customer.

To provide power for the new mill a transformer station was built. There are three unit substations in the mill area, two of 1000 kva and one of 1500 kva.

Compressed air for the new mill is taken from the plant system, but in order to assure sufficient pressure a new compressor was installed to feed into the plant system.

Air-Pollution Instruments

INSTRUMENTS widely used for measuring atmospheric pollution in Great Britain were described by A. Parker and S. H. Richards at the first United States Technical Conference on Air Pollution, meeting in Washington, D. C., recently.

Mr. Parker is Director of Fuel Research, Department of Scientific and Industrial Research, London, England, and Mr. Richards is superintendent of Observations, Atmospheric Pollution Research, Fuel Research Station at London.

Introduced in 1916, the deposit gage was the first type of apparatus for measuring air contaminants widely used by local British authorities, the scientist pointed out. Today, about 300 gages are in regular use in Great Britain. The deposit gage consists of a glass collecting bowl supported on metal tripod. Material deposited on the bowl passes down a connecting pipe into a bottle. The gage is examined once a month.

Two types of smoke filters are used for measuring suspended solid impurities in the air. An Owens automatic air filter is used to obtain hourly readings of smoke concentrations in the air, and a newer-type smoke filter is used for daily observations. In both methods, solid particles from the air are collected on a filter paper, form a circular stain, and the density of the smoke is measured, they said. The newer-type filter was used extensively in a special survey of atmospheric pollution at Leicester during 1937-1939.

In 1932 a new method for recording the extent of atmospheric pollution by sulphur dioxide was devised by the Building Research Station of the D.S.I.R., the authors disclosed. This method, based on the facility with which sulphur dioxide in the air is absorbed on a prepared lead-peroxide surface to form

lead sulphate, has found wide application, they stated. About 400 stations in Great Britain are now equipped with lead peroxide instruments.

The volumetric sulphur dioxide apparatus also is used to a lesser extent for determining concentrations of sulphur dioxide in the air. A measured volume of air is bubbled through a dilute solution of hydrogen peroxide, and the sulphuric acid formed is estimated.

Upgrading Coal

TO help increase the nation's supply of bituminous coal suitable for making metallurgical coke, the Bureau of Mines of the U. S. Department of the Interior has found that large reserves of high-sulphur Pittsburgh-bed coal in southwestern Pennsylvania and northern West Virginia can be prepared or "upgraded" for use as a metallurgical fuel, according to a Bureau bulletin.

Pittsburgh-bed coal containing as high as 2.27 per cent sulphur in the raw state can be treated successfully for coke-making, the Bureau report discloses. Low-sulphur coals in the Pittsburgh, Pa., region have been used for more than a century in making coke, but the declining production of this quality fuel has necessitated the extension of coke-making operations into higher-sulphur coal reserves.

In preparing high-sulphur coals in the Pittsburgh area for coke making, washing is a common practice for reducing the sulphur content of coals, according to the Bureau report. In the same area, coke-oven operators for many years have mixed high and low-volatile coking coals in order to improve the average quality of the resultant coke and to make available a wider range of coals for coking.

The extreme variability of Pittsburgh coal in respect to sulphur content increases the difficulties in preparing this coal for coke making and no one method of cleaning is considered satisfactory for upgrading these high-sulphur coals. Selective mining, low-gravity separation, fine crushing, and froth flotation, and combinations of the three are suggested methods of reducing the sulphur content.

Experimental results on various samples in the Pittsburgh area are given in graph and table form, along with statistics on the shipment of by-product coals and coal-cleaning practices in the region.

Copies of Bulletin 483, "High-Sulphur Pittsburgh Coal: Upgrading in Southwestern Pennsylvania and Northern West Virginia," are sold by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 30 cents each.

Atomic Golf Ball

AN atomic golf ball that can't get lost was demonstrated recently by the B. F. Goodrich Company at Akron, Ohio. Minute quantities of radioactive materials embedded under the cover of the ball makes it possible for a caddy carrying a small portable Geiger counter to locate the "atomic" golf ball even when hidden in dense woods or deep rough.

The location of a lost ball can be telegraphed by the Geiger counter in two ways: (1) By a flashing light on the instrument; (2) by signals which the caddy can hear through headphones.

Dr. William L. Davidson, director of Goodrich's physical research, said the project is experimental and that no sale of radioactive golf balls is contemplated at the present time, but added that this peacetime application of atomic energy may eventually solve the problem of the lost golf ball. He said there are about 25,000,000 balls sold each year and that it is estimated that about 50 per cent of these are lost at one time or another.

At the demonstration the radioactive golf balls were driven into a wooded area and each time the caddy located the ball with the aid of the Geiger counter. Although the instrument used today is somewhat heavier, Dr. Davidson said that there is a new Geiger counter on the market which weighs only ten ounces and costs about $25, the price of about 25 golf balls.

He said that the amount of radioactive material inside each ball is so small that there is no danger of radiation.

Pinned-Up Mine Roof

TO increase the safety and convenience of underground miners, the Tennessee Coal, Iron & Railroad Company, Birmingham, Ala., has cleared all upright timber supports from more than 5 million sq ft of its coal and iron-ore mines, and has installed "pinned-up" mine roof supports.

This means that men no longer have to wrestle with big machines and haulage cars in narrow areas between posts erected to support the roof. Their movements are freer than ever before in underground operations of this kind.

The mine roof is literally pinned to solid rock above the working areas. As soon as miners have opened a space for working, holes are drilled through the overhead coal or ore and soft slate or shale to hard rock. In the holes, a slotted bolt of strong steel is wedged. The end of the bolt which projects below the roof level is threaded; on it is fastened by means of an ordinary steel nut a large square steel plate which is as effective in holding up the roof as an upright timber.

To date, there have been no accidents from fall of roof in either coal or iron-ore mines directly caused by the new method of roof support. In fact, the frequency of accidents in TCI ore mines in 1949 was the lowest in the company's history, in the first eight months standing at 8.32, a reduction of 54 per cent from the same period in 1948.

Meantime, the quality of product has greatly improved. With the advent of the pinned-up roof, slate picked from the mine-run ore has declined from an average of 275 tons a week before the pinned-up roof was introduced, to practically zero.

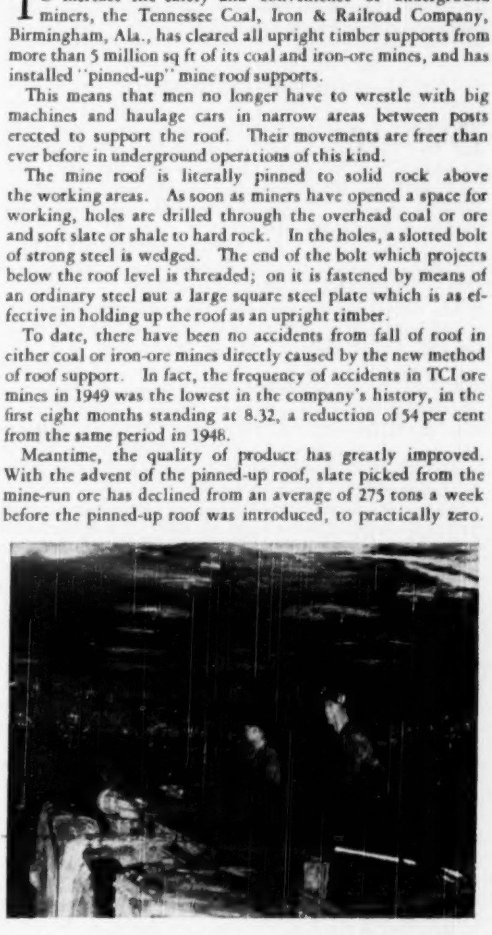


FIG. 4 THIS INTERIOR VIEW OF AN UNDERGROUND MINE SHOWS THE SQUARE STEEL PLATES OVERHEAD WHICH HOLD UP ROOF, ELIMINATING USUAL UPRIGHT TIMBER SUPPORTS

There has also been a reduction of the acid content of conditioned ore by about 2 per cent.

Good rivet-grade steel is used for the bolts. This provides a minimum ultimate strength of 56,000 psi, assuring that a 1-in. bolt will support 33,600 lb of roof on its threaded end and 44,000 lb on its anchored end. To develop a bolt design that would consistently provide anchorage strength sufficient to develop the full tensile strength of the bolt, tests were made on various designs and sizes of wedges, rods, and holes. After installation, the test bolts were pulled by a hydraulic jack rig until they broke and the tensile strengths were noted.

The steel bolts used to support TCI mine roofs are of various lengths, depending on use. The trend in coal mines is to use bolts long enough to penetrate the draw slate and anchor in the sandstone roof. Practice in the ore mines is to use bolts long enough to anchor the roof in an arch formation, the entire arch anchored to the solid rock above it. In some cases, instead of plates, steel channels are fastened to the pins to hold up larger roof areas where clearance is provided.

Steel Production

During a great surge of output in April and May, U. S. steel companies for the first time in history were pouring more than 1,900,000 tons of steel a week, according to the June, 1950, issue of *Steel Facts*, published by the American Iron and Steel Institute. They held their production at that high level for over six consecutive weeks.

That was more steel in a week than many countries make in an entire year. For example, it was more than the 1949 output of Australia, Sweden, or India individually.

Steel's unprecedented feat, made possible by the companies' huge programs of expansion and improvement in recent years, reflected general business activity. Automobile production was running ahead of 1949, the record year. A boom was under way in the housing industry. Household appliances were being turned out at a record rate. Numerous other lines of business were unusually active. Total national employment rose sharply until nearly 59 million persons were at work. The United States generally was enjoying one of the greatest production eras in its history.

More steel was made in May than in any previous month. The May output exceeded 8,500,000 tons. It was the fourth month in history in which more than 8,000,000 tons had been made, the others being January and March, 1949, and April, 1950. In April, steelmaking furnaces, operating at 100.2 per cent of capacity, made 8,196,000 tons.

Six weeks in succession, starting April 17, steelmaking furnaces were operated at an average of 100 per cent of capacity or better. The peak was 101.8 per cent of capacity, at the rate of an annual output of over 100,000,000 tons of steel.

The high demand for steel was intensified by the fact that more than one million tons of steel were lost during the strike of coal miners in January, February, and March.

At the end of April, steel companies had produced a total of about 372,000,000 tons of ingots and steel for castings since the end of the war. That was about 45,000,000 tons more than was made during the war, from December, 1941, to August, 1945, inclusive.

Outstanding in high level of business activity has been the exceptionally high number of housing units started last winter, leading to a monthly record of 126,000 family units in April.

Most spectacular from its immediate significance to steel is the production of the automotive industry. Despite a strike closing the plants of the second largest maker of cars, the auto plants have been turning out 12,000 to over 100,000 cars more each month than a year earlier. Shipments of steel to this industry in March broke all monthly records with a total of 1,208,000 net tons, 21.5 per cent of steel shipments.

Another active demand is from household appliances, which took more steel in March than in January or February.

The annual report of one of the large oil companies said: "The rapid expansion of oil-producing facilities, rather than any falling off in oil use, enabled the industry to meet all its customers' needs throughout 1949." Oil-producing facilities are made almost wholly of steel, at the rate of more than 4 million tons a year, equal to 7 or 8 per cent of steel shipments.

Jetliner Test Progress

More than 100 hr of flight tests have been completed on the Avro Canada Jetliner. The Jetliner has been making as many as five flights daily recently in preparation for its Certificate of Airworthiness. Serviceability is said to have been excellent.

During the course of these tests, the Jetliner has been flown at more than 500 mph in level flight, establishing a new North American speed record for its type. Its cruising speed of 450 mph is more than 100 mph faster than the conventional air transports now in service. The aircraft has attained a height of 39,500 ft, 9500 ft higher than its normal cruising height. Many three-engined take-offs have been carried out at various speeds and at maximum gross weight; and a number of times the aircraft has been flown with only one engine at about 200 mph with no decrease in altitude.

A number of test flights have been made over a triangular course of about 800 miles between Toronto, North Bay, and Montreal, and the average time has been about two hours. These flights carried out at cruising altitude show that about 1600 Imperial gal (1920 U. S. gal) of fuel have been used. The production version will have a fuel capacity for 3330 Imperial gal (4000 U. S. gal). One flight of over 1100 miles has been made.

Demonstration flights have been made to New York, Ottawa, and Montreal in half or less than half the time taken by present airliners on the same routes. The 365-mile flight to New York was particularly interesting, as the first official mail ever carried in a jet transport was carried on this flight. Since this time the aircraft has been inspected and flown by leading airline officials and pilots in the United States and Canada.

Passengers who have flown in the Jetliner claim that all sensation of speed and height is lost except perhaps when flying in the vicinity of clouds. They have particularly noted that there is virtually no vibration and what noise is present is of a steady air-flow type and not accompanied by propeller and exhaust beat.

According to Avro Canada, in the flights carried out to date, there have been no unusual handling problems either in the air or on the ground. At Malton Airport where the test flights are normally carried out, there are all sorts of airplanes from helicopters and light aircraft to conventional twin and four-engined transports, and there has never been any trouble fitting the Jetliner in with local traffic.

Although the Jetliner is a 500-mph aircraft, experience has shown that it can be flown easily at 140 to 150 mph in a circuit, and as a result of the light, responsive, and well-harmonized controls 360-deg turns easily can be made inside the perimeter of modern airports.

The final approach and landing of the Jetliner have proved to be easily and safely carried out. Experience has shown that the Jetliner's final approach speed is 125 to 130 mph with an ample margin of safety. This tapers off to about 115 to 120

over the edge of the field, and the actual touchdown is at 95 to 100 mph which makes stops in normal runway lengths easily. The exercise of great judgment on the approach is not required as the Derwent engines respond very well to the throttle. The practice is to approach at a minimum rpm of about 7500 which provides little thrust, but allows the throttles to be opened just as fast as in the case of reciprocating engines. Even from full idling the response is very good and the throttles can be fully opened in well under ten seconds. Once the throttles of propeller-driven aircraft are closed there is a sharp deceleration and sink due to the drag of the propellers, but jet-powered aircraft give the feeling of free-wheeling so there is not the same urgency about restoring full power. On the other hand, the designers have incorporated sufficient drag into the flaps so that with them fully lowered the Jetliner does not float so badly that the throttle must be closed early. It has not been necessary to throttle back fully on the Jetliner until just before rounding out for the landing.

Under certain conditions the Jetliner's endurance can be increased by stopping two of the four engines. This is quite practical with the Derwent turbojet engines, as relighting in flight can be accomplished as a normal operation.

No starting troubles have been experienced with the Jetliner, and all four engines can be started in less than 2 minutes. There is no flame from the jet pipe and experience has shown that it is possible for the aircraft to move away from a ramp with no danger and no discomfort to observers close at hand.

Due to the level attitude of the aircraft, there is no particular heat problem as regards runway surfaces. No damage at all is done to concrete runways by the Jetliner and none to asphalt surfaces during the "run-up" for take-off. Prolonged engine runs, however, should not be carried out on asphalt, especially if the weather is hot.

The length of the Jetliner's take-off run compares favorably with that of present-day transports. The aircraft accelerates quickly, thus allowing an unusually steep angle of climb for obstacle clearance.

It has been found possible to use high climb speeds for the Jetliner when climbing through turbulent air. Experience indicates that as a result of the "stiffness" of the wing, which is designed to withstand severe gusts at high cruising speeds, the aircraft rides through normal turbulence at a much higher speed than conventional transports and there is no uncomfortable wallowing and much less jolting.

While it is too early to evaluate the expected extended life of instruments and equipment on the Jetliner due to its almost complete lack of vibration, nevertheless there has been remarkably little trouble with the aircraft's instruments, accessories, and equipment to date.

$500 Jet Helicopters

ACCORDING to various helicopter manufacturers, privately owned jet helicopters may become a reality in the not too distant future.

An article in the CADO *Technical Data Digest* indicates that the Air Materiel Command has been watching the development of commercial versions of jet helicopters in the Little Henry (XH-20) class with interest because of the potential value of such an aircraft to the Air Force. In addition, the ground forces have a requirement for an inexpensive easy-to-operate helicopter for liaison and observation purposes.

Several manufacturers, including Sikorsky, McDonnell, Hiller, American Helicopter, and Marquardt are actively working on helicopters of this type. Many are predicting the development of a jet helicopter, the production model of which will be designed to sell at around $500 after initial development and tooling costs have been written off.

Some of the newer concepts of a small helicopter will use a pulsejet system because this type of engine is more suitable for subsonic operation than the ramjet and consequently will operate on a lower fuel consumption.

The original version of the McDonnell Aircraft Corporation's Little Henry was designed as a test stand to prove the utility of the ramjet engine for use on military helicopters. It is equipped with simple controls, stick collective pitch control, rudder pedals, and throttle. Fuel for the craft is carried in two tanks, located on both sides of the pilot, and piped up through the rotor blades to the engine.

The Little Henry weighs only 280 lb and has a design gross weight of 620 lb. Diameter of the single rotor is 18 ft. The craft itself is $12^1/_2$ ft long and 7 ft high.

The ignition system of the little helicopter consists of a spark coil connected to the rotor-head distributor system which fires one jet's spark plug at a time. The ignition is used for starting only, since the two 6-volt dry cells installed behind the pilot seat carry enough current to energize the spark coil.

The cost of constructing jet helicopters is much lower than that of conventional helicopters, because of the simplicity of the components. A pulsejet engine, consisting of a "stovepipe" type of duct and shutter, can be mass-produced for about $50, and ramjets for a lesser amount. Few engine accessories are needed. For instance, only a simple fuel pump driven by the rotor is necessary. The structure is very simple and comparatively light inasmuch as it supports only the pilot, the fuel tank, and a few simple controls.

In comparison, a conventional small helicopter requires a $3000 reciprocating engine, an expensive transmission, a complicated fuel system, a structure heavy enough to support this equipment, a heavy landing gear, and numerous control instruments. A helicopter of this type sells commercially for about $25,000.

The placing of the new low-price helicopter on the market will depend on the amount of money industry has available for complete development, government interest in the project, and the size of the potential market.

Procurement officials reveal that several of the companies engaged in the development of the lightweight helicopters have announced that they have a model which has a range far greater than the 30-min operation of present-day helicopters which will eventually be suitable for commercial use and which can be manufactured at a low cost.

Hot-Spot Machining

ADDITIONAL data on hot-spot machining, a completely novel approach to metal cutting, are described in reports now available to the public, the Office of Technical Services of the U. S. Department of Commerce announced recently.

Research on hot-spot machining, undertaken by Sam Tour and Company, Inc., for the U. S. Navy's Bureau of Ships, was directed to finding whether the energy consumed, time involved, and results achieved in machining metal stock could be substantially improved by heating the work rather than by cooling the tool.

Reasoning that tool failure is the mechanical inability of a heated tool to withstand the shear force and resistance to plastic deformation of a cold workpiece, the contractor undertook to reduce the shear force of the workpiece by heating it just ahead of the cutting operation. Work was concentrated on proving the feasibility of hot-machining rather than in developing specific techniques.

Tests run to date, according to this report, indicate that hot-machining which has been given preliminary investigation from time to time in the past, will be a "vital contribution to machining methods." The additional rapidity of this method can be indicated by the fact that desirable metal removal rates were estimated to be three to 200 times faster than possible with machining at room temperatures. According to the report, a special application alloy formerly classed as unmachinable, can be readily machined by this method.

Additional advantages of hot-spot machining, according to tests described in the report, are the production of a smooth continuous chip on most of the steels tested, and absence of tool-wear difficulties, breakage of carbide insets, or tool chatter.

The hot-turned surfaces of the test pieces are described as noticeably superior to cold-turned surfaces cut under similar conditions. Difficulties in the machining of stainless alloys have been largely eliminated.

Details of complete tests made with both flame heating and electrically induced heating are given with preference apparently going to the latter.

Report PB 99978, "Hot Spot Machining," 37 pages, including photos, graphs, drawings, and tables, sells for $2.25 in microfilm, $5 in photostat. Orders should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., and should be accompanied by check or money order payable to the Librarian of Congress.

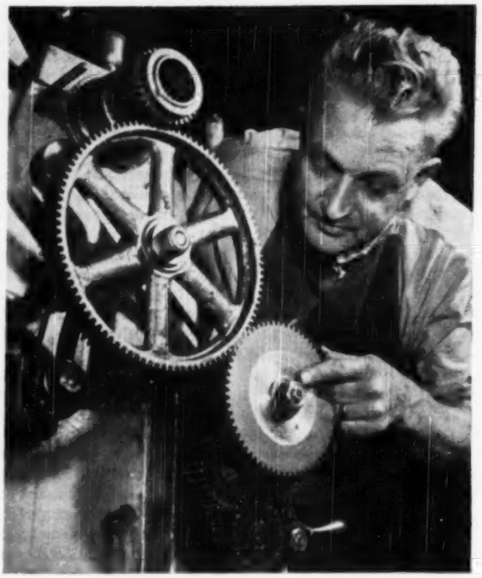


FIG. 5 GEORGE BRUSH, OF UNITED STATES RUBBER COMPANY'S FORT WAYNE, IND., PLANT, POINTS OUT DRIVE GEAR WHICH WAS MOLDED FROM ENRUP, THE COMPANY'S NEWLY DEVELOPED THERMOSETTING PLASTIC

(The gear has been operating in this 36-in. heavy-duty lathe for more than six months without visible signs of wear. The lathe is powered by a 5-hp 1750-rpm motor.)

New Plastic

DEVELOPMENT of a tough new plastic, called "Enrup," which promises to become one of the basic raw materials of the rubber industry, was announced recently by the United States Rubber Company.

The new plastic bridges the gap which has existed between soft rubber and hard rubber for almost a century, the company said.

It fulfills an urgent need for a high-strength material which is resistant to abrasion and chemicals and at the same time can be produced in varying degrees of flexibility ranging between elastic soft rubber on the one hand and brittle hard rubber on the other.

One of its outstanding uses is for the manufacture of high-strength low-cost gears to replace metal gears in such applications as heavy-duty lathes, household appliances, plating barrels, automotive timing devices, and dynamometers.

Gears made of the new plastic are said to have been operating for more than a year in applications where conventional metal gears have failed within a few weeks. These gears were molded in one piece to close tolerances, which eliminated the need for elaborate finishing operations.

The plastic is particularly suited for washing-machine parts where its resistance to the newer type of synthetic detergents has given it an advantage over metal.

Among other promising applications for the plastic are: fuel-pump parts, battery cases, dies and jigs, valve seats, buckets for carrying chemicals, plating barrels, filter press plates, photostat separator plates, tote boxes, bearings, electrical insulators, and various automotive parts such as camshaft timing gears, water-pump impellers, ignition-coil housings, distributor caps, low-load and low-speed bearings and bushings.

The new plastic, it is reported, has demonstrated remarkable toughness, resistance to abrasion, and resistance to the deteriorating effects of oils, solvents, acids, and mild alkalies. It is light in weight and extremely stable at high temperatures. It has good resistance to fire and its high dielectric strength makes it a good electrical insulator. It is thermosetting.

It is said to have an impact strength which is superior to most plastic materials now being marketed, and it can be molded economically in complicated shapes by either compression or transfer methods.

Rubber Design Data

RUBBER and rubberlike resilient materials are used today so extensively in many important functional mechanical applications that more technical information about them is constantly in demand by the design engineers. In a paper, "Design Data on Natural and Synthetic Rubbers for Mechanical Engineers," which E. F. Riesing, Mem. ASME, Firestone Industrial Products Company, Noblesville, Ind., presented before the 1949 ASME Annual Meeting in New York, N. Y., an attempt was made to provide such design information.

Properly compounded, Mr. Riesing said, natural rubber and recently developed synthetic elastomers that are rubberlike in behavior provide the designer with engineering materials having specific and tailored properties to fill the requirements of practically an endless number of problems. These are the materials that will endure where no other material can qualify under the abusive action of repeated impact, continuous flexing and stretching, vibration, abrasion, and the destructive action of chemicals, oils, weather, ozone, and the like.

The major portions of Mr. Riesing's paper appear in the latest (12th) edition of Kent's "Mechanical Engineers' Hand-

book" in the Design and Production volume, section 5, pages 57 to 69.

Specifically, in addition to providing simplified methods for calculation of rubber designs, the paper gives nominal safe working loads and suggested strain limitations. Data are presented on the effect of the angularity of the unstressed sides in bonded sandwiches with sides other than normal to the bonded surfaces. Detailed data are presented on the physical properties of compounds of five basic elastomers in three different hardness ranges, as well as the effect of temperature on these properties, with particular emphasis on modulus. A constant effort has been made to distinguish between hardness, as measured by surface indentation, and true modulus.

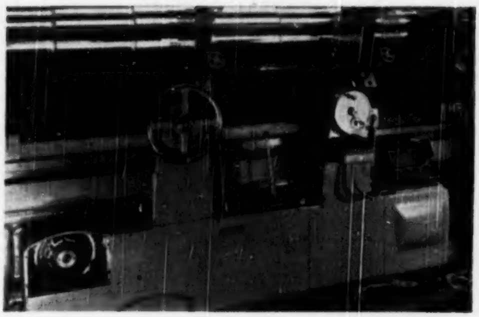


FIG. 7 CONTROL APRON OF 40-TON PLAIN GRINDER

40-Ton Plain Grinder

WHAT is believed to be the largest plain grinding machine ever made has recently been completed by The Churchill Machine Tool Company, Ltd., of Broadheath, Manchester, England. It was designed to grind various sizes of turbine-rotor shafts for power-station generating equipment. The largest shaft will weigh about $14^1/_2$ tons.

The machine has a maximum swing of 54 in., will admit a length of 288 in. between centers, weighs approximately 40 tons, and has a length of 57 ft. An outstanding feature of this large machine is the layout of the control apron. Because of the large diameter of the shafts which will be ground, the machine is much higher than the average plain grinding machine. The operator stands on a platform from which he has an eye-level view of a mirror on the wheelhead in which he sees the grinding wheel making contact with the work. The two controls which will be in use most frequently—the wheelhead feed and the hand traverse to the table—are raised to a comfortable operating level and the electrical control desk is mounted on the right-hand side of the platform. The apron contains the grinding-wheel feed gearing, the traverse-drive gearbox and reverse mechanism, the hand-traverse reduction gear, also the variable-dwell mechanism which operates at each reversal of the table traverse, and the power-traverse disengagement lever.

The length of traverse stroke is adjusted by means of trip dogs on a rack on the front of the table which make contact with a reverse lever at the end of each traverse stroke. The table weighs 11 tons and the full weight with workhead, steadies, and tailstock is approximately 15 tons.

The grinding wheelhead is driven by a 25-hp variable-speed motor. Quick power movement is provided for positioning the wheelhead to cover the several diameters of the rotor shafts. This consists of a motor mounted on the wheelhead base, driving through suitable gearing. The control for this movement is by a lever attached to the right-hand side of the grinding wheel feed column. Movement either way disengages the feed wheel and operates the motor in either direction for inward or outward movement of the wheelhead. Limit switches are fitted to the side of the wheelhead to prevent damage to the feed mechanism by over running.

The body of the machine is in two parts which are bolted and keyed together. They are of massive proportions, with exceptionally wide vee and flat slideways. Automatic lubrication is provided for the table slideways and consists of small valves at intervals on the body which are opened only as the table passes over them. Surplus oil drains back into the supply reservoir. A small motor-driven pump supplies oil under pressure for the system.

The workhead contains a gearbox giving 8 speeds and in

FIG. 6 VIEW OF 40-TON PLAIN-GRINDING MACHINE GRINDING A 4-TON SHAFT

conjunction with the variable-speed motor gives a complete range of speeds. When setting up, an "inching" button is provided on the workhead to enable the operator to engage the driver with the work-drive carrier or clamp.

The tailstock has wheel and tommy-bar adjustment for the center and is also provided with a setover adjustment to insure correct alignment. Workhead and tailstock are easily moved along the table ways by means of geared racking devices.

Two capacities of adjustable work-steady are supplied with the machine to support the varying diameters of rotor shafts which the machine is to grind.

A-Bomb Casualty Studies

JAPANESE survivors of the atomic bombings at Hiroshima and Nagasaki have apparently recovered from the acute or immediate effects of the bombings, but within recent months the first evidence of delayed effects—the formation of eye cataracts—has come to light, according to records of the Atomic Bomb Casualty Commission of the National Research Council.

Since 1947, with the support of the Atomic Energy Commission, the ABCC has conducted continuous studies of the medical and genetic effects on the populations of the two bombed cities.

The Japanese survivors make up the only group of human beings in the world who have been exposed to an atomic-bomb burst. For this reason the medical findings of the ABCC have important significance for scientists and for military and civil defense planning in the United States. To date ABCC has accumulated some data on more than 150,000 persons in the bombed area.

Scattered studies of the effects of the bomb blast were begun by medical observers attached to the Allied occupying forces in 1945.

At the present time the Japanese survivors have recovered from such effects as loss of hair, temporary infertility, and blood changes. The study of long-range effects, such as effects on growth, tumor or eye-cataract formation, and genetic changes, will require many years.

Following the discovery that radiation similar to that released in an atomic-bomb burst had caused cataracts to form in the eyes of research workers in this country, a preliminary ophthalmic survey was started at Hiroshima last year. This survey revealed ten cases of cataracts believed to have been caused by the atomic bomb. Subsequent examination of 1000 persons, most of whom were within 3000 ft of the point above which the bomb exploded, has led to the discovery of about 40 certain cases of radiation cataract and an additional 40 suspected cases.

A full-scale ophthalmological study is now under way at Hiroshima, and a survey of survivors at Nagasaki is also planned.

The medical follow-up of births in the two cities was begun in 1947, and to date approximately 35,000 births have been investigated. It has been estimated that at least 200,000 births must be studied in order to detect small changes in the frequencies of congenital and inherited abnormalities.

In addition to using clinical methods to detect abnormalities present at birth, the ABCC, wherever possible and with the cooperation of the Japanese people, makes routine autopsies on stillborn infants and infants dying soon after birth.

All live births are checked. In addition, the ABCC hopes to give each infant a follow-up examination at age one year. This will confirm earlier diagnoses and detect congenital and inherited abnormalities which often are difficult to discover in the newborn.

In 1947 and 1948 a survey of approximately 300 exposed children and 300 normal Japanese children was undertaken to determine possible differences in growth and development between these two groups. These pediatrics studies have been continued by the ABCC. By the end of 1949 almost 2800 initial clinical examinations had been made under the program, and 186 follow-up examinations were made during the year 1949.

Also, in 1949 the ABCC conducted a survey of 5000 marriages to determine frequencies of various degrees of marriage between blood relations in Japanese communities. From a genetic point of view such marriages are of considerable interest, since they increase the chance for observing inherited family traits in the offspring. Such knowledge will assist in the evaluation of genetic effects observed in survey cities and will assist scientists in comparing the Japanese data with those reported in other parts of the world.

According to present radiation-census records, about 900 persons are definitely known to have been within 3200 ft of the on-the-ground center of the explosion. The estimated number of survivors originally within the 6500-ft zone, where radiation sickness was common, was approximately 80,000 in Hiroshima and 15,000 in Nagasaki. Many of these persons have since left the area. At present approximately 28,000 survivors still are believed to live within the 6500-ft zone. However, in order to get this sample it will be necessary to screen several times that number of persons.

Railway Rolling Stock

(*Continued from page 642*)

ing cycles. Such studies should permit a new design which will delay or retard the types of wear and thermal failures which are occurring, especially in high-speed service.

Manufacturers' technical groups and individual railroad groups who are endeavoring to solve this problem must discard all preconceived ideas and untested theories and secure the help of skilled research technicians who can rapidly assist in advancing the proper solution.

The railroad industry should accelerate its studies of one of the most recently recognized practices in machine fabrication—the creation of residual compression in the part. This art had been practiced by a chosen few for centuries without realizing what the underlying theory encompassed.

Methods of evaluation of residual stress are of fairly recent origin and tedious to follow; consequently, optimum practices were developed only after many failures. We know now that cold-forming of boilers and fireboxes left damaging tensile stresses in critical areas which could have been corrected by using methods which introduced compressive stresses in such areas. Riveted joints are still the subject of much design controversy. Areas subject to tensile stresses could be much benefited by inducing residual compression.

One of the most fertile fields for mechanical researchers is this field of stress investigation.

In another field—nuclear research—radioactive isotopes are now available for the determination of more efficient metals.

Top men in the AAR are as progressive as can be found in any organization. Yet they must look to the railway mechanical engineer to project the policies in this type of pioneering. Thus the railroad industry requires of you the vision and courage to advance beyond present frontiers.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

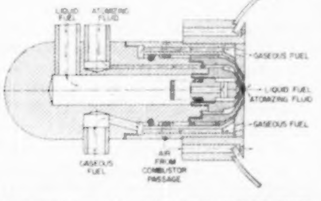
Gas-Turbine Power

Gas-Turbine Combustors for Gaseous Fuels, by K. L. Rieke and A. E. Hershey, Mem. ASME, Westinghouse Electric Corporation, East Pittsburgh, Pa. 1950 ASME Semi-Annual Meeting paper No. **50—SA-31** (mimeographed).

THE use of natural gas for industrial and domestic heating has been increasing at an accelerated rate during the past few years. One such application is in the form of a gas-turbine-driven booster unit for gas pipe-line pumping. A gas turbine, burning natural gas and driving a centrifugal compressor, would appear to have a number of advantages, among which the most important are the small floor space and foundation needed, the small amount of power required for auxiliaries, and the fact that no cooling water is necessary.

When it was decided to modify the Westinghouse 2000-hp experimental gas-turbine unit, which has been under test since August, 1946, the problems associated with the combustion of natural gas in such a unit were relatively unexplored. This paper reviews the test and development work which has been carried out at the Combustion Laboratory at East Pittsburgh, in order to provide a satisfactory combustor design for this gas turbine.

With the final combustor passage design the conversion of the unit from burning a liquid to a gaseous fuel can be accomplished quite readily by interchanging a set of fuel nozzles. Since certain operating conditions may require an instantaneous change from one fuel to the other, a dual-fuel nozzle has been developed and tested. The performance with this nozzle using distillate fuel or natural gas has been good. The change from one fuel to the other may be made at any operating condition. The liquid-fuel nozzle uses an auxiliary fluid to get increased atomization, and while air is normally used as the atomizing fluid, the gaseous fuel serves equally well.



COMBINATION GASEOUS AND LIQUID-FUEL NOZZLE

The performance of the gas-turbine booster unit has provided substantial confirmation of the combustion test results obtained in the laboratory; in particular, it has demonstrated that either a liquid or gaseous fuel may be burned satisfactorily in the same flame tube, provided correct fuel and air distribution are established in the combustion zone. At the present time experimental work is in progress in an attempt to devise a target-type pyrometer for the measurement of gas temperatures in the combustion zone as an aid in achieving the optimum fuel and air distribution.

Further investigation of premixed combustion is also being considered, since it should be possible to develop more compact combustor designs using this type of flame, though such combustors would not be likely to perform as satisfactorily with liquid fuels.

Safety Margins and Stress Levels in High-Temperature Equipment, by Ernest L. Robinson, Fellow ASME, General Electric Company, Schenectady, N. Y. 1950 ASME Semi-Annual Meeting paper No. **50—SA-28** (mimeographed; to be published in Trans. ASME).

THE factors of safety and working stress levels currently in use in high-temperature equipment are reviewed and their relationship to physical properties at high temperature as determined by the various kinds of tests currently in use are discussed. Differences between different industrial applications are pointed out in comparison with the general rules at present used by the General Electric Company.

According to the paper, machines and equipment now being built and placed in service at temperatures of 900 to 1000 F and higher have for the most part more adequate margins of safety relative to the strength of the materials at operat-

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ing temperatures than did similar equipment built 20 years ago before the common use of molybdenum-bearing steels and other heat-resisting alloys. This is true of steam turbines as built by G-E. Such a conclusion is based on the comparison of design stresses with test results using all applicable test methods. Without such use of test results, however arbitrary, there can be no satisfactory assurance of safe operation under advanced conditions.

Aviation—Helicopters

The Helicopter Pressure Jet, by Friedrich L. B. Doblhoff, McDonnell Aircraft Corporation, St. Louis, Mo. 1950 ASME Semi-Annual Meeting paper No. **50—SA-36** (mimeographed).

THE inherent characteristics of pressure-jet drive systems for helicopters are reviewed. It is found that low specific consumption of jet engines is achieved under the same set of conditions that make the turbine discharge air suitable for ducting through rotor blades prior to expansion. Very low specific consumption must be reached before satisfactory blade conditions are brought about and exhaust cooling, regeneration, or turbine ducting must be employed.

Even with inefficient basic jet engines satisfactory blade duct conditions can be achieved by modification of the cycle, but power-plant development for specific helicopter purposes would be required.

Use can be made of existing power plants by resorting to tip burning. Low fuel consumption is sacrificed, but significant gains can be made for rotary-wing aircraft in which rotor propulsion is called upon but for short portions of the total flying time.

Hovering and Low-Speed Performance and Control Characteristics of an Aerodynamic-Servocontrolled Helicopter Rotor System as Determined on the Langley Helicopter Tower, by Paul J. Carpenter, NACA, Langley Air Force Base, Va. 1950 ASME Semi-Annual Meeting paper No. **50—SA-30** (mimeographed).

IT has been thought that some type of servomechanism to control the blade pitch of a helicopter rotor may be desirable in certain cases, for example, in large rotors where excessive control forces and pitching moments may be encountered. Accordingly, tests were made on the Langley helicopter tower to determine the performance and control characteristics of an aerodynamic-servo-controlled helicopter rotor system. It was intended that an investigation of this configuration would give fundamental information of a general nature on rotors and such control systems.

The rotor differs from conventional rotors by the unique method of controlling the blade pitch. In this rotor configuration, the blade is attached rigidly at the root, and pitch change is effected by twisting the blade at an outboard station by means of an aerodynamic flap instead of by rotating the blade at the root.

This paper presents measurements of the rotor performance for hovering and low forward speeds and measurements of the aerodynamic-flap servo-control characteristics. The results are discussed and some comparisons are made with conventional rotors, that is, rotors with pitch actuation accomplished by rotating the blade roots.

Applied Flight Research as Performed by the Air Materiel Command, by N. R. Rosengarten and Major Vernon Prentiss, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio. 1950 ASME Semi-Annual Meeting paper No. **50—SA-24** (mimeographed).

THE Flight Test Division of the Air Materiel Command is responsible for evaluating flight characteristics of all experimental and production aircraft to determine if they meet USAF specifications. The Flight Research Section of the Flight Test Division conducts applied research in order for the Flight Test Division to better perform its mission by devising new methods in keeping up with trends of progress, and by revising old methods in order to produce more accurate results in the simplest and least-time-consuming manner. The Flight Research Section, in a broad sense, was formed first, to develop techniques of flight testing and methods of application to new types of aircraft and second, to conduct research into and formulate methods of instrumentation and installation. Quite often this organization acts as an adviser or service organization to tactical units. Requests from these organizations are on a demand basis and might range from a problem of determining the maximum allowable Mach number for an airplane in a dive to the problem of determining the best technique of establishing a new world's aircraft speed record. This organization has liaison with all aircraft manufacturers, the NACA, the Army, and the Navy.

The Flight Research Section consists of some 30 personnel—11 military, 8 engineering aides, and the remainder engineers in some branch of engineering.

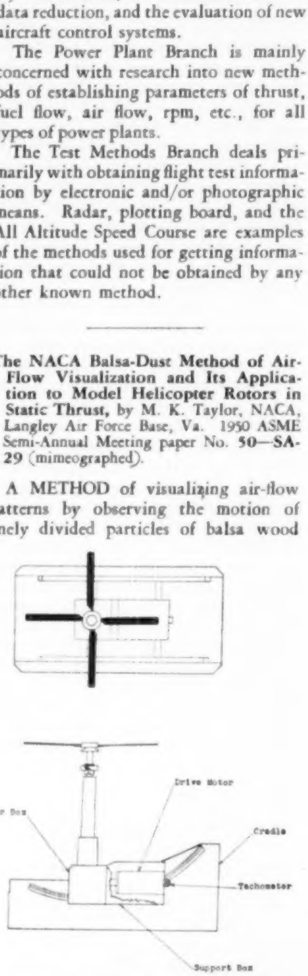
There are three branches of the Flight Research Section. The Aerodynamics Branch, the Power Plant Branch, and the Test Methods Branch. The primary function of the Aerodynamics Branch is to develop and evaluate new methods of flight testing and data reduction for the purpose of obtaining additional or improved aerodynamic data. This includes the determination of aircraft and helicopter frequency response and stability derivatives, machine methods of data reduction, and the evaluation of new aircraft control systems.

The Power Plant Branch is mainly concerned with research into new methods of establishing parameters of thrust, fuel flow, air flow, rpm, etc., for all types of power plants.

The Test Methods Branch deals primarily with obtaining flight test information by electronic and/or photographic means. Radar, plotting board, and the All Altitude Speed Course are examples of the methods used for getting information that could not be obtained by any other known method.

The NACA Balsa-Dust Method of Air-Flow Visualization and Its Application to Model Helicopter Rotors in Static Thrust, by M. K. Taylor, NACA, Langley Air Force Base, Va. 1950 ASME Semi-Annual Meeting paper No. **50—SA-29** (mimeographed).

A METHOD of visualizing air-flow patterns by observing the motion of finely divided particles of balsa wood



SCHEMATIC DIAGRAM OF MODEL COAXIAL HELICOPTER

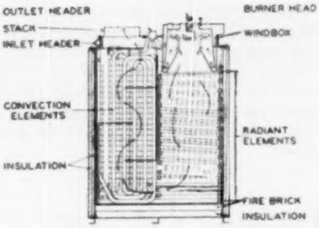
introduced into the air has been developed by the NACA. The method, which is discussed in detail, is simple to use and requires only a supply of balsa wood, a camera, and some easily purchased photographic lamps. The results indicate the feasibility of using the NACA balsa-dust technique for obtaining air-flow patterns for transient as well as for steady-state conditions.

Since the first multiple-rotor arrangement scheduled for full-scale tunnel tests is a coaxial system, a coaxial model having a diameter $^1/_{15}$ that of the full-scale rotor was constructed. This scale was chosen to permit investigating the flow patterns in various forward-flight conditions in the $^1/_{15}$-scale model full-scale tunnel. In this paper the results obtained in the static-thrust condition only are presented. These results are in the form of still photographs and motion pictures and include, for comparison purposes, information obtained with one of the rotors removed from the coaxial model configuration. The effect of placing a ground plane at several distances from the rotor is shown and photographs of the air-flow distribution resulting from a rapid increase in rotor thrust are also included. Limited studies were also made using a model biaxial helicopter.

Railroads

Treating Feedwater for Railway Diesel Steam Generators, by John F. Wilkes, Dearborn Chemical Company, Chicago, Ill. 1950 ASME Semi-Annual Meeting paper No. **50—SA-18** (mimeographed).

WITH the advent of Diesel-electric motive power in the railway field, it was assumed by many that problems of water supply and treatment would be substantially eliminated. It soon became apparent, however, that Diesel operation created several new and specific water-treatment requirements. Even on Diesel-powered trains there was a continuing demand for steam in large volumes, to be used in heating, cooling, or air-conditioning passenger equipment, heating water for lavatories, steam tables in diners, and similar services. Furthermore, cold-weather operation soon demonstrated an additional requirement for steam to prevent freezing of Diesel-engine cooling systems during out-of-service periods. Therefore, in designing Diesel-electric locomotives, it was necessary to provide compact, oil-fired steam generators to supply the required steam demands.



SECTION THROUGH STEAM GENERATOR

These steam generators are complex in design and constitute a difficult water-treating problem. To prevent malfunction resulting from scale formation and corrosion, use of mineral-free, corrosion-inhibited feedwater is recommended. Economical ion-exchange systems have been designed to produce high-quality feedwater.

Satisfactory protection against scale formation and corrosion also can be obtained by internal treatment methods, using new potassium-based treatments. Polyamide antifoam compounds may be required to control excessive carry-over.

Use of inhibited acid at controlled temperatures and concentrations, followed by rinsing and neutralization of residual acid, are recommended to prevent corrosion of steam-generating tubes and appurtenances during descaling operations.

Dynamics of "Shimmy" in Passenger-Car Trucks, by S. G. Guins, Mem. ASME, The Chesapeake and Ohio Railway Company, Cleveland, Ohio. 1950 ASME Semi-Annual Meeting paper No. **50—SA-21** (mimeographed).

A SERIES of tests conducted on the Pere Marquette District of The Chesapeake and Ohio Railway to investigate the causes and the cures of shimmy motion gave conclusive data that this type of truck motion can be not only controlled but prevented if a proper angular damping is introduced between the truck frame and the car body.

It is pointed out, however, that the material discussed in this paper concerns only one phase of passenger-truck dynamics and therefore the cures developed will not necessarily be a cure that should be used when one encounters severe lateral oscillations in a passenger car.

Of all the data obtained the following seemed to be the most outstanding: First, the motion characteristics of shimmy, that is, frequency and amplitude were generally independent of the physical components of the truck suspension; second, the forces causing the motion originated at the point of contact between the wheel and the rail; third, the resultant motion was a combination of angular and pure lateral oscillations. The data on this last portion were not complete, because at the time the tests were started no thought was given to angular motions, and therefore it was not clear which of the two motions was the cause of shimmy. When testing was resumed three possible cures were proposed—two to control angular motion and one to control lateral motion.

These cures are discussed in detail and it is concluded that very soft angular control, if applied to a truck with new wheels, will prevent any tendency of the truck to shimmy, and without any danger of unsafe operation on the curves and crossovers due to excessive angular restraint.

Power

A Cyclone-Fired Pressurized Steam Generator, by Merle Newkirk, The Dow Chemical Company, Midland, Mich. 1950 ASME Semi-Annual Meeting paper No. **50—SA-38** (mimeographed).

THIS steam-generating unit has a rated capacity of 400,000 lb of steam per hr, generating steam at 1250 psig and 900 F, and fired with crushed, not pulverized, coal by two horizontal cyclone burners. The boiler unit has a total heating surface of 37,339 sq ft and a furnace volume of 24,900 cu ft.

All air and fuel is admitted to the cyclone primary furnace, and the flame and products of combustion discharge through a conical opening into the secondary furnace, where they are directed downward by water-cooled reflecting tubes so that they sweep the molten slag on the secondary furnace floor. The flame and gases then turn through a slag screen and pass upward through the secondary furnace to the convection section. In the convection section are located a continuous tube-draining-type superheater, the secondary section of the continuous-tube economizer, and the boiler-generating-tube section. The gases turn through the convection section and continue their flow downward through the first gas pass of the secondary air heater, over the primary economizer, then turning upward and passing through the second gas pass of the secondary air heater, on through a welded flue to the primary air heater, and finally out the stack.

Experience with the cyclone-fired pressurized setting indicates that radical improvements can be made on present coal-fired steam generators, such as (1) Coal need not be pulverized, and those coals which have been uneconomical to

prepare can now be handled successfully; (2) with clean combustion, the heat-absorbing surfaces can be arranged more effectively; (3) superheaters can be placed among the generating tubes, making them smaller and more easily de-dusted; (4) the entire structure of the unit can be arranged for bottom support, and not hung from the top to expand down; (5) the most important is the application of a hot-air turbine to supply air for combustion; (6) circular form lends itself readily for ease of construction and semioutdoor installations; (7) opposed firing will simplify the ash disposal.

Production—Machine Design

Contour Turning, by K. T. Kuck, The Monarch Machine Tool Company, Sidney, Ohio. 1950 ASME Semi-Annual Meeting paper No. **50—SA-8** (mimeographed).

GLASS mold shops were among the first to demonstrate the tremendous advantage to be gained in transferring to contour-turning machines the work previously performed by more complicated and costly methods. The difficulties present in making molds and dies, even the simplest ones, together with a growing shortage of sufficiently skilled men to perform satisfactorily the intricate and accurate work required, started Monarch toward simplifying the necessary metal-removing operations.

The first work on shape turning naturally grew out of co-operating with the glass industry in solving some of its container problems. A partial solution of these called for a device which would make it possible to turn, bore, and face contours of circular cross section; and a device which, in addition to its ability to generate such contours parallel to the axis of the workpiece, could also machine ovals, triangles, squares, hexagons, octagons, and other geometric shapes, whether flat, concave, or convex.

The first of these objectives was accomplished by the Monarch-Keller form-turning machine. In operation this tool is guided in the work by means of a profile tracer which engages a thin sheet-metal template which is the exact cross section of the workpiece.

Longitudinal and cross-feeds for each direction of operation are secured from magnet clutches driving the carriage and cross slide of the lathe. These clutches are of pancake design and are mounted in a quick-change gearbox driven by a variable-speed motor in order to provide a wide range of feeds.

This machine permits the accurate machining of such things as round glass-bottle molds, forming dies, punches, spinning chucks, etc.

The next development was an oval chuck with which it was possible to turn an elliptical section, and, when used in conjunction with the Keller controls, to profile the ellipse.

This combination made it possible for the first time to machine with facility such work as oval-shaped bottle molds, molds for glass baking dishes, and dies and punches for hollow ware of all types.

As this was being developed and employed successfully on various geometric patterns, more attention was directed toward obtaining still greater flexibility in the turning of cross-sectional shapes on changing contours, such as being able to bore a mold for a flat bottle and automatically change the contour to blend the flat portion of the bottle to the round neck section. The mechanism to perform these operations, when added to previous designs, culminated in the Monarch "Shapemaster."

Today it is possible to turn an oval cross section with flutes on the contour of the oval and then, by an automatic stroke-changing device, to shift automatically from an oval to a circular section carrying the flutes on all sections, or gradually eliminate them as desired. From this setup, which is possibly the most complicated of all, it is possible to machine molds with as many as 500 sides or flutes, either flat, convex, or concave, each flute being an exact duplicate of every other.

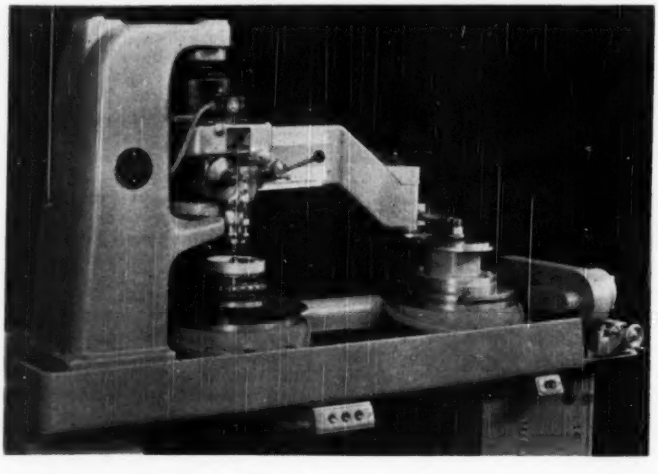
New High-Accuracy Cam-Contour Mill Design and Applications, by A. D. Gunderson, George Gorton Machine Company, Racine, Wis. 1950 ASME Semi-Annual Meeting paper No. **50—SA-7** (mimeographed).

MORE than two years ago the George Gorton Machine Company sold a standard pantograph machine to a customer who required equipment to profile precision cams of varied shapes in short runs. While the standard pantograph was thoroughly satisfactory for the short run and variable shape characteristics, it did not provide the amount of accuracy which the user eventually desired.

Many months later a problem was presented to the sales department by another manufacturer of precision cams. The requirements were for the machining of cams approximately $^1/_2$ in. thick × $1^1/_8$ in. in diam, of SAE 4615 steel and with 10 to 15 rms surface finish, with a tolerance of 0.0005 in. or better. These cams were cast integral in a zinc flywheel-type housing, with an outer flange extending higher than the cam itself. This eliminated all possibility of employing conventional cam-grinding techniques.

Furthermore, the requirements in this instance were for long production runs of identical cams.

Integral holding fixtures, cutter feeds, specifications, power drives, coolants, cutters, reduction ratio, testing, applications, and the like are presented.



CAM CONTOUR MILLING MACHINE

Comprehensive Analysis of Motor Performance on Turret-Lathe Duty Cycle, by R. H. Schuman, The Warner and Swasey Company, Cleveland, Ohio. 1950 ASME Semi-Annual Meeting paper No. **50—SA-2** (mimeographed).

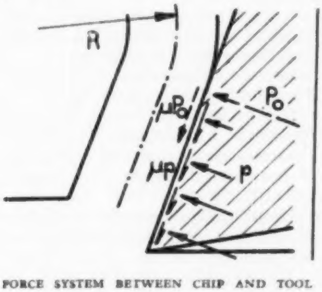
DURING the work cycle of many machines, the drive motor must change speeds, reverse, start, and stop. Each of these changes produces heat in the motor. This heat may be the limiting factor in the number of work cycles the machine can make in a given time.

Careful consideration of the factors involved is always necessary during the original design of a machine of this type to be certain that this limit is well beyond normal requirements a user would place on the machine. However, regardless of how much more than adequate a machine is for its normal purpose, unusual requirements will always arise. Jobs, for example, which require an insignificant amount of cutting time and an abnormally large number of motor changes may reach the motor-heating limitation.

This paper reviews the analysis and use of correlated performance characteristics of a turret lathe which imposes severe duty-cycle loads on its motor. A new, more inclusive method of analysis is presented which applies to the more complex problem of including changes in rotary inertia during changes in motor speed.

The Stress Distribution in the Continuous Chip—A Solution of the Paradox of Chip Curl, by E. K. Henriksen, Cornell University, Ithaca, N. Y. 1950 ASME Semi-Annual Meeting paper No. **50—SA-9** (mimeographed).

THE fact that a chip passes along the tool face for a certain distance before it leaves the tool and curls through space has been investigated and leads to the assumption of a sudden drop in pressure at the point of ultimate contact combined with a concentrated single force at this point.



FORCE SYSTEM BETWEEN CHIP AND TOOL FACE

The physical origin of this system of forces is explained by surface roughness of the tool, and it leads to an explanation of the very sharp boundary line for the area of wear on the tool face.

The distribution of pressure between chip and tool follows an exponential law.

A stress analysis for the chip gives an explanation of the following three phenomena: (1) The downward concave curvature of the "plane of shear"; (2) the "chipping off" of thin layers forming the built-up edge; and (3) the structure of deformation in the chip.

Accurate Spring Counterbalancing, by W. S. Rouverol, University of California, Berkeley, Calif. 1950 ASME Semi-Annual Meeting paper No. **50—SA-6** (in type; to be published in Trans. ASME).

THE design of spring counterbalances for commercial purposes customarily has involved a sacrifice in accuracy for the sake of simplicity and economy. Overhead garage doors, automobile trunks, pipe hangers, and many other such products are ordinarily provided with a simple form of spring loading which produces true equilibrium at some central position but 10 to 15 per cent over or under-balancing at the extreme positions. This paper shows that this compromise with real accuracy is unnecessary and describes a method for attaining perfect full-rotation counterbalancing by the proper connection of a standard helical spring.

Displacement Vs. Time Characteristics of Hydraulic Actuators, by L. Sigfred Linderoth, Jr., Mem. ASME, Iowa State College of Agriculture & Mechanic Arts, Ames, Iowa. 1950 ASME Semi-Annual Meeting paper No. **50—SA-5** (mimeographed).

IN designing complex hydraulic equipment, particularly equipment in which several hydraulic actuators must operate with definite relations to each other, it becomes necessary for the design engineer to know with reasonable certainty what the characteristics of the motion of the actuator will be.

This paper develops the relation between the displacement and time of a piston in a hydraulic actuator in terms of the load, mass, pressure drop, viscosity, and special operating conditions. It is based on the Fanning law of friction in pipes and the value of the friction factor in smooth pipes as given by Hagen-Poiseuille and Blasius. The relation developed will cover most conditions met in the design of hydraulic equipment and

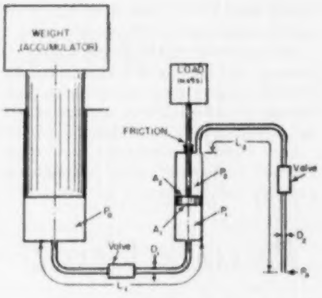


DIAGRAM OF THE COMPONENTS IN THE HYDRAULIC SYSTEM

will suggest a means to analyze these conditions not covered. This method is valid for pressures up to 100 atm and, with modifications, to higher pressures.

Blast Furnaces

Dehumidification of Air for Dry Blast, by John Everetts, Jr., Charles S. Leopold, consulting engineers, Philadelphia, Pa. 1950 ASME Process Industries Division Conference paper No. **50—PRI-1** (mimeographed).

THE detrimental effect of moisture in blast-furnace air was recognized in the steel industry over one hundred years ago.

Theoretically, the removal of one grain of moisture per cu ft of blast-furnace air will result in a saving of 41 lb of coke per ton of pig iron, due to reduced moisture-dissociation energy loss. For a 1000-ton per day furnace, and with a moisture reduction from 6 to 3 grains per cu ft of air, the saving would be approximately 61.5 tons per day, or about 7 per cent. If the moisture removal were from 6 grains to 1 grain per cu ft, the saving would theoretically be increased to 12 per cent. In addition, there would be an increase in pig-iron production.

There are four general methods for removing moisture from blast-furnace air: (1) Mechanical refrigeration, (2) absorption refrigeration, (3) solid sorbents, and (4) liquid sorbents.

Each of these methods may be used in a precompression or postcompression system. Although the postcompression system may appear more efficient, because it is easier to remove moisture at 20 psig than at atmospheric pressure, it presents many disadvantages from a design and maintenance standpoint. If the blowing engines are of the reciprocating type, the pulsations will be damaging to any cooling coils. Any oil or dirt carried over by the air will clog coils or ruin any sorbent materials

which means a by-pass with valves to permit maintenance without shutdown.

The precompression system, that is, treating the air before it enters the blowers, is the more accepted method because of accessibility of equipment and easier maintenance and repair.

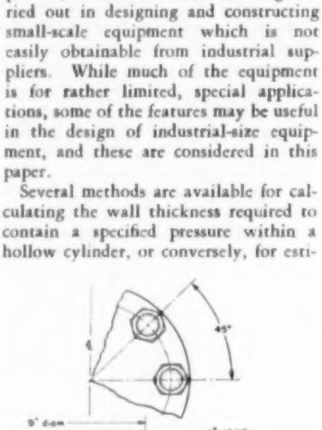
The relative advantages of these available dehumidification systems are explored and discussed in the paper.

Pressure Vessels

Techniques in High-Pressure Vessel Design, by E. L. Clark, A. M. Whitehouse, and H. J. Kandiner, Bureau of Mines, Bruceton, Pa. 1950 ASME Process Industries Division Conference paper No. **50—PRI-13** (mimeographed).

THE Bruceton laboratories of the Bureau of Mines are engaged in research and development of synthetic-liquid-fuel processes. One of the processes being investigated, the direct hydrogenation of coal, requires the use of high pressures and temperatures. In the course of laboratory and pilot-plant studies of this process, considerable work is being carried out in designing and constructing small-scale equipment which is not easily obtainable from industrial suppliers. While much of the equipment is for rather limited, special applications, some of the features may be useful in the design of industrial-size equipment, and these are considered in this paper.

Several methods are available for calculating the wall thickness required to contain a specified pressure within a hollow cylinder, or conversely, for estimating the stress due to a given pressure in a given vessel.



BRIDGMAN VESSEL CLOSURE UTILIZING INTERNAL PRESSURE TO EFFECT A SEAL

In place of the present ASME code procedure (for thick-walled vessels at pressures up to 3000 psi) for determining vessel wall thickness for vessels in the 5000 to 15,000-psig range, the authors prefer to use 50 to 75 per cent of the yield point as an allowable stress value, taking into account the test pressure needed and the service of the vessel, and to use the maximum strain-energy theory to calculate the vessel wall thickness. For high-temperature service at high pressure, the allowable stress in the material should be selected as that stress needed to cause 1 per cent deformation at 10,000 or 100,000 hr at the design temperature, allowing for control fluctuations due to faulty operation.

The authors prefer a pressure-energized type of closure, particularly for high-temperature service. Close limitations must be considered, however, before selecting a specific closure, particularly for large-diameter high-pressure vessels.

ASME Transactions for July, 1950

THE July, 1950, issue of the Transactions of the ASME contains the following:

TECHNICAL PAPERS

The Influence of Shape of Cross Section on the Flexural Fatigue Strength of Steel, by T. J. Dolan, J. H. McClow, and W. J. Craig. (49—A-55)

Hide-Out of Sodium Phosphate in High-Pressure Boilers, by F. G. Straub. (49—A-39)

Chemical Treatment, Demineralization, or Evaporation for Make-Up in High-Pressure By-Product Steam Plants, by J. D. Yoder, W. L. Webb, and T. Baumeister. (49—A-71)

Sulphite and Silica in Boiler Water at Springdale, by L. E. Hankison and M. D. Baker. (49—A-75)

An Automatic Degasser for Steam Sampling in Power Plants, by H. M. Rivers, W. H. Trautman, and G. W. Gibble. (49—A-74)

The Quality of Steam Condensate as Related to Sodium Sulphite in the Boiler Water, by R. C. Alexander and J. K. Rummel. (49—SA-37)

Feedwater Treatment During Early Operation of Steam-Electric Stations, by R. C. Alexander and J. K. Rummel. (49—SA-48)

Allowable Eccentricity of Spherical Heads Convex to Pressure, by R. G. Sturm, L. W. Smith, and H. L. O'Brien. (49—A-70)

Effect of Welding on Pressure-Vessel Steels, by A. F. Scotchbrook, L. Eriv, R. D. Stout, and B. G. Johnston. (49—A-49)

Some Factors Influencing the Economics of Reheat Installations, by R. W. Hartwell and H. A. Wagner. (49—A-100)

Selection of Steam Conditions for No. 4 Unit—Riverside Generating Station, by R. C. Dannettel and G. S. Harris. (49—A-62)

A Comparison of Costs of Reheat Versus Nonreheat for 100-Mw Units, by R. P. Moore. (49—A-99)

General Discussion of Reheat Papers.

Analysis of Experimental Data Regarding Certain Design Features of Pressure Vessels, by G. J. Schoessow and E. A. Brooks. (49—F-19)

Experimental Technique in Pressure-Vessel Testing, by L. F. Kooistra and R. U. Blaser. (49—F-20)

Effect of Pressure on the Combustion of Pulverized Coal, by T. T. Omori and A. A. Orning. (49—A-72)

Continuous Gasification of Pulverized Coal With Oxygen and Steam by the Vortex Principle, by H. Perry, R. C. Corey, and M. A. Elliott. (49—A-73)

The Gas-Turbine Regenerator—the Use of Compact Heat-Transfer Surfaces, by A. L. London and W. M. Kays. (49—SA-9)

A Perforated-Plate Heat Exchanger, by H. O. McMahon, R. J. Bowen, and G. A. Bleyle, Jr. (49—A-92)

Effect of Size on the Design and Performance of Internal-Combustion Engines, by C. F. Taylor. (49—A-116)

Influence of Compressibility on Cylindrical Pitot-Tube Measurements, by L. W. Thrasher and R. C. Binder. (49—A-31)

Determination of ASME Nozzle Coefficients for Variable Nozzle External Dimensions, by R. G. Folsom. (49—A-110)

The Response of Thermocouples to Rapid Gas-Temperature Changes, by M. W. Carbon, H. J. Kutsch, and G. A. Hawkins. (49—A-148)

Crude-Oil Flow Characteristics Experienced in Large-Diameter Lines, by L. E. Anderson. (49—PET-13)

Surge Problems in Pipe Lines—Oil and Water, by S. L. Kerr. (49—PET-9)

Pressure Losses in Tubing, Pipe, and Fittings, by R. J. S. Pigott. (49—PET-22)

Attenuation of Oscillatory Pressures in Instrument Lines, by A. S. Iberall. (49—IIRD-5)

Long-Time Tension and Creep Tests of Plastics, by C. E. Staff, H. M. Quackenbos, Jr., and J. M. Hill. (49—A-61)

Accelerated-Cavitation Research, by W. J. Rheingans. (49—A-140)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Rating Study

To the Editor:

I note in the June, 1950, issue of Mechanical Engineering that Mr. Bochenek reports the recent SAM-ASME time-study and methods conference. He describes the paper of Herbert A. Lynch, Jr., of New York University who is preparing a study of operation performance. This no doubt refers to the study which Mr. Lynch has undertaken for the SAM rating project. The following paragraph characterizing the work of Mr. Lynch is one with which we who are associated as engineers with the labor movement will take strong exception. Mr. Bochenek states, "It would provide an objective standard for reference in disputes about accuracy of specific time standards and could also be used to train or retrain time-study engineers, union officials, and members of management."

The final results of Mr. Lynch's study cannot constitute any objective standard. His results will represent at best a frequency distribution of the prejudices of a large group of engineers concerning what they would like to establish as normal performance.

I have spoken to each member of the sponsoring committee and informed them exactly what my attitude is. They have assured me that Mr. Lynch's study is not supposed to result in any official society code. I think that this ought to be made clear in Mechanical Engineering lest any misinformed engineers assume that the standards resulting from the Lynch study possess an official status.

Might I add that I would be presumptuous to object to any study that any group wishes to make, and it is not my intention to attempt to dictate either the subject matter or results of any study.

However, before the results of any study are lent even a semiofficial status, we expect that all parties interested and affected by the results of these studies will be consulted. It might be a good idea to schedule a symposium on the methodology and results of Mr. Lynch's study at the next annual meeting of the ASME, inviting interested parties to attend such a meeting, rather than having it overweighted with "official discussers." Certainly the subject matter is important enough to warrant a prominent place in the proceedings of the society.

William Gomberg.[1]

[1] Director, Management Engineering Department, International Ladies' Garment Workers' Union, New York, N. Y. Mem. ASME.

Heat Transfer

To the Editor:

We have read with considerable interest the review of "Heat Transfer," vol. 1 by Max Jakob, as prepared by Prof. Charles E. Lucke.[2]

While we are in agreement with many of the reviewer's comments in so far as some of the specific text material is concerned, we are certainly not in accord with the closing remarks of the reviewer, and feel that they may be misleading to prospective readers of the text. With this in mind we are, therefore, requesting that the opinions of others familiar with the book be published in order to avoid any misunderstanding on the part of your readers.

It is our understanding that Dr. Jakob's book is intended as a review and discussion of the important fundamental concepts in heat transfer. The book was not intended, for example, as a competitor to Professor McAdams' excellent compilation of heat-transfer data.[3] Nor, in our belief, was the book intended for the person with only a minor interest in heat transfer. We believe that the book should have been reviewed in the light of the existing literature and gaged in terms of its value to the serious worker in the field.

The reviewer points out in his closing remarks that two broad classes of subject matter have not only been omitted, but ignored. But as we have noted, the text was never intended for a handbook or engineering code wherein designing engineers, according to the reviewer, would be able to find:

(*a*) "Working equations of rational form with empirical constants for the boundary resistance of any fluid under any of the circumstances that may exist in full-scale commercial heat-transfer apparatus of all sorts, sometimes classified as heat exchangers, and the over-all resistance between the higher-temperature source of heat and the low-temperature receiver. This includes all sorts of gas, liquid, vapor, and solid heaters and coolers, vapor condensers, and liquid evaporators."

(*b*) "The basic equation, with corresponding working equation of rational form for the heat absorbed by the surroundings of any combustion chamber, the exit-gas temperature, and the heat remaining as sensible heat of exit gases, for any fuels in every sort of fuel-fired equipment, including industrial furnaces, boilers, stills, and the like; also internal-combustion engines and gas turbines."

It is our belief that the book constitutes an excellent contribution to the heat-transfer literature and will be found very useful by engineers and scientists deeply interested in the subject of heat transmission. There is a need for more books to cover the subjects mentioned by Professor Lucke, but we do not agree that Professor Jakob should be criticized for not writing them.

Myron Tribus.[4]
G. A. Hawkins.[5]
L. M. K. Boelter.[6]

To the Editor:

The view point of Professors Tribus

[2] "Heat Transfer," Reviews of Books, Mechanical Engineering, vol. 72, February, 1950, pp. 168–171.

[3] "Heat Transmission," by W. H. McAdams, McGraw-Hill Book Company, Inc., New York, N. Y., 1933.

[4] Assistant Professor of Engineering, University of California, Los Angeles, Calif. Jun. ASME.

[5] Visiting Professor, Department of Engineering, University of California, Los Angeles, California, and Professor of Thermodynamics, Purdue University, Lafayette, Ind. Mem. ASME.

[6] Dean, College of Engineering, University of California. Mem. ASME.

and Hawkins might be regarded as representative of the academic, pedagogic, or scientific group, and it might well be different from that of the industrial group which includes the designers of all equipment constructed and the operators of that equipment in regular service.

CHARLES E. LUCKE.[7]

[7] Professor Emeritus, Mechanical Engineering, Columbia University, New York, N. Y. Fellow ASME.

The following comments have to do principally with the so-called "appraisal ratio" which is a new factor to this commentator, even though he has been connected with research, at the receiving end as it were, for many years. Having heard many research directors hem and haw when trying to evolve the estimates necessary for evaluating the appraisal ratio, the writer wonders if it isn't the author's intention to say that the most important characteristic of a research director is that he be willing and able to make valid estimates of these three factors. It is, of course, realized that a good research director is mentally making such estimates right along, either actually, or subconsciously. It is important to stress the fact that high validity in this type of estimating is extremely difficult, and that "patient money" is the type which does not continually censure a research director for fallacious estimating. It might be a good thing for management never to expect the research director to give the value of this ratio in writing until one of his projects has reached a fairly complete stage.

The paper has been of tremendous benefit to this writer, who can be considered a member neither of management nor research. He represents that fairly large group of engineers who jump into action as soon as the products of research have reached a certain stage and who sit on the side lines cheering both management and research when they make favorable evaluations of the factors of the appraisal ratio.

Management and Industrial Research

COMMENT BY Z. G. DEUTSCH[8]

The writer was present during the original presentation of this excellent paper,[9] and was so enthralled by its clarity and the soundness of its main thesis, that he was unable to make any comment until after more mature study.

There can be no quarrel with any of the author's statements. However, the petroleum industry is hardly typical in the picture of applied research drawn by the author. It is true, of course, that General Electric, Westinghouse, Eastman, et al., have long practiced that type of applied research which has made American industry the envy of the industrialized portion of the world and of the scientifically minded fraternity as a whole. The automobile industry is also admired for its prompt utilization of the results of research. Other industry groups, however, are not such admirable examples to mention in connection with prompt application of the latest scientific discoveries to the benefit of an industrial civilization. Almost anyone will agree that the older basic industries such as steel, heavy chemicals, and chemical products from coal-processing definitely lag behind the petroleum and consumer-machinery industries.

From the writer's observations, both at home and in a few other industrialized countries of occidental culture, it is usually the younger industry that exhibits the vigorous utilization of the products of applied research in benefiting both itself and its customers. In western Europe the cartel way of doing business, and the much narrower base of ownership of industry, are in sharp contrast to the United States and Canadian practices. Elsewhere, the failure to keep industries virile by the jungle rule of "apply research or be bankrupt" has been distressingly obvious to American engineers and businessmen since the close of World War II. This paper ought to be required reading for all boards of directors of industries in the ECA countries!

[8] Deutsch and Loonam, Consulting Engineers and Metallurgists, New York, N. Y. Mem. ASME.

[9] "The Attitude of Management toward Industrial Research," by R. E. Wilson, MECHANICAL ENGINEERING, vol. 72, January, 1950, pp. 8-11.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Phenomena, Atoms, and Molecules

PHENOMENA, ATOMS, AND MOLECULES: An Attempt to Interpret Phenomena in Terms of Mechanisms or Atomic and Molecular Interaction. By Irving Langmuir. Philosophical Library, Inc., New York, N. Y., 1950. Cloth, $5^1/_2 \times 9$ in., figures, table, Bibliography, Index, xi and 436 pp., $10.

REVIEWED BY W. JULIAN KING[1]

THIS is a remarkable book, written by a remarkable man. Irving Langmuir, Holley Medalist in 1934, winner of the Nobel Chemistry Award in 1932 for his work in surface chemistry, and honored by degrees from such universities as Johns Hopkins, Harvard, Oxford, Columbia, and Princeton, has published some 200 technical papers on basic physics and chemistry during his 41 years in General Electric's main Research Laboratory at Schenectady. In this, his first book, he has collected what might be called his "classic" papers on surface chemistry, kinetic theory, atomic hydrogen, heat and mass transfer, and the physical chemistry of atoms, molecules, and electrons—together with three striking papers dealing with contemporary scientific, social, and political philosophy.

The technical papers alone might conceivably justify the rather remarkable price of $10 for a small volume of 436 pages. Most of them, of course, will interest principally the "pure" scientists and research engineers, but several will appeal to more practical-minded engineers and others who enjoy good nonfiction. Chapter seven, for example, is labeled "Atomic Hydrogen as an Aid to Industrial Research," but it includes an interesting "History of the Gas-Filled Lamp," a section captioned "Better Education Needed" and another on "The Value of Hobbies." However, most of the papers contain straightfor-

[1] Melville Medalist, 1945; Professor, Department of Engineering, University of California, Los Angeles, Calif. Mem. ASME.

ward, lucid, and well-documented treatises on such subjects as as the distribution of molecules, flames of atomic hydrogen, the dissociation of hydrogen into atoms, isomorphism, isostenism and covalence, and evaporation and condensation.

The first three chapters, on the other hand, are in quite a different category, as suggested by their titles: chapter one: "Science, Common Sense, and Decency"; chapter two: "Discussion of Science Legislation"; and chapter three: "World Control of Atomic Energy." Dr. Langmuir makes some striking statements that are certain to cause repercussions among the metaphysicians and social philosophers. Referring to the revolutionary effect of Einstein's and Planck's theories, he remarks, "Perhaps the most important aspect of this is that the scientist has ceased to believe that words or concepts can have any absolute meaning." (He does not mention Korzybski's "General Semantics.") Even more striking is his designation of *convergent* and *divergent* phenomena. Convergent phenomena are "those in which the behavior of the system can be determined from the average behavior of its component parts"—the ordinary workaday events obeying the laws of cause and effect. Divergent phenomena are *inherently unpredictable*, arising from single discontinuous events (such as a single quantum change) which may have far-reaching effects, such as the precipitation of a world war. He thus divides the world into a region of law and order wherein science can deal in a very limited way with convergent phenomena, and a somewhat disconcerting region where absolutely unpredictable and extremely minute events may set off all sorts of chain reactions upsetting the best laid plans of mice and men. His philosophy will give great comfort to the enemies of science and the proponents of the spiritual and mystical kingdoms.

Chapters two and three contain impressive accounts of his observations in Soviet Russia after the war, and his views on our federal policies affecting science and atomic energy. He says, "In Russia they are frankly incorporating into their communistic government some of the best features of our capitalism while we tend to put into our democracy some of the worst features of communism—now discarded in Russia. Thus the efficiency of labor will increase in Russia while in America the stifling of incentives through taxation, the regulation of industry, and unwise labor legislation may impair our capacity to produce. We talk too much about personal security and not enough about opportunity." He says other things about Russia that may get him into trouble with our thought-police or the Inquisitor General, and he says more about our political and economic philosophy that is well worth reading.

The final 36 pages of the book are given over to a complete bibliography of Langmuir's publications and an excellent subject index.

The Creep of Metals and Alloys

THE CREEP OF METALS AND ALLOYS. By E. G. Stanford. Temple Press, Ltd., London, England, 1949. Cloth, $5^1/_4 \times 8^1/_2$ in., tables, 32 figures, References, pp. 128–151, Bibliography, xvi and 162 pp., 15s.

REVIEWED BY J. J. KANTER[2]

A NUMBER of books have been published on the subject of creep of metals in the quarter century since its study became a matter of technical importance. Mr. Stanford's work is perhaps unique in its devotion to an account of the present state of theory of the subject.

The book embraces five chapters and two appendixes of references and bibliography. The first chapter on the conditions required for the measurement of creep is written in the light of the author's experience with measurements on aluminum alloys. The creep curve is the subject of a chapter in which the physical interpretations associated with graphical presentations of data are treated. The factors which influence the creep of metals is discussed in another chapter under three main headings, namely, grain size, heat-treatment and structural stability, and chemical composition. A chapter on the presentation of creep results delves into the essential considerations pertinent to basing engineering design upon such results. The final chapter on the physical study of the mechanism of creep, for which Mr. Stanford's book has a new character among texts on the subject, commends the work to students of the physics of metals.

The treatment of the subject as a whole by Mr. Stanford is rather preoccupied with the creep test per se and is rather light in coverage of the stress-rupture aspect of the subject, a matter which has become of great interest to the American investigators and engineers concerned with high-temperature structures. This observation is not offered as a criticism of the work but merely to clarify further the theme covered.

[2] Directing Engineer, Research and Development Laboratories, Crane Co., Chicago, Ill. Mem. ASME.

Time Travel

THE OMNIBUS OF TIME. By Ralph Milne Farley. Fantasy Publishing Co., Inc., Los Angeles, Calif., 1950. Cloth, $5^1/_4 \times 8^3/_4$ in., 315 pp., \$3.50.

THIS book is a collection of short stories that originally appeared in magazines which relatively few engineers are likely to read. According to that most recent of biographical reference books, "Who Knows—and What Among Authorities, Experts, and the Specially Informed," the author, who writes under a pen name, is a specialist in exterior ballistics and psychrometry, has been a senior instructor in advanced mathematics, and has been head of the legal and patent department of a manufacturing company in the Middle West since 1921. He belongs to a remarkable group of "writers of science-fiction" who use that medium of expression to relieve the tensions of the intellectual life imposed on them by scientific study by giving free rein to their imaginations in concocting weird and fantastic tales based on scientific theory and speculation.

Mr. Farley's field in science fiction is time travel, and in the introduction to this collection of his stories he says that he "may possibly be entitled to lay claim to having employed more varied theories as to time than any other author." "The Omnibus of Time" is convincing testimony in support of this claim. Following the sixteen stories, in a concluding chapter, aptly called "After Math," Mr. Farley presents the theories of time advanced by Einstein, H. G. Wells, Riemann, Eddington, and the Encyclopedia Britannica, as well as his own theory, on which his tales are based, and shows how each theory is used as the basis of his

fictional treatment. The stories themselves show how one moves forward or backward in time—time travel—if these several theories of time are applied. The results are fantastic, amusing, and ingenious. The reader is introduced to the man who met himself, the one who became his own grandfather, the student who did two weeks' study for an examination overnight merely by varying the rate of entropy change, the lawyer who went back in time twice and found himself present on the second occasion, and the aviator, who, because of a lamination theory postulated by Mr. Farley, traveled not into the future but into an entirely different space-time continuum from our own and thus became invisible. There are many more. The reader who has any scientific imagination will find that these fantastic tales permit him to time-travel out of his humdrum existence into new fields of adventure. G. A. S.

Books Received in Library

ASTM SPECIFICATIONS FOR STEEL PIPING MATERIALS, prepared by ASTM Committee A-1 on Steel, December, 1949. American Society for Testing Materials, Philadelphia, Pa. Paper, 6 × 9 in., 328 pp., illus., diagrams, charts, tables, $3. The standards included in this volume cover pipe used to convey liquids, vapors, and gases at normal and elevated temperatures; still tubes for refinery service; heat-exchanger and condenser tubes; and boiler and superheater tubes. Specifications for such allied materials as castings, forgings, bolts, and nuts are also included.

AMERICAN SOCIETY FOR METALS TRANSACTIONS, Vol. 42, 1950. American Society for Metals, Cleveland, Ohio, 1950. Bound, 6 × 9¼ in., 1356 pp., illus., diagrams, charts, tables, $10. Approximately fifty papers, presented at the American Society for Metals Annual Convention in October, 1949, are published in this volume. The papers printed here are from the sessions on alloy steels, oxidation, quenching, high-temperature metallurgy, transformation and temper brittleness, stainless steels, mechanical metallurgy, atomic energy metallurgy, and nonferrous metals and alloys. A detailed subject index is provided. Officers' reports and information on other society affairs are also included.

APPLIED THERMODYNAMICS PROBLEMS FOR ENGINEERS. By W. J. Peck and A. J. Richmond. Longmans, Green and Co., New York, N. Y.; Edward Arnold & Co., London, England, 1950. Linen, 5½ × 8¾ in., 344 pp., diagrams, charts, tables, $4. This book is a synopsis of the fundamental calculations of the subject and provides a widely representative selection of fully worked examples together with some explanatory material. Standard proofs of mathematical expressions are omitted except where they are dealt with as problems. It is intended for use as a supplement to existing textbooks and to classroom instruction. Intermediate and final answers are given for the unworked examples at the end of each chapter. A knowledge of applied heat or of heat engines is assumed.

AUTHOR'S GUIDE FOR PREPARING MANUSCRIPT AND HANDLING PROOF. John Wiley & Sons, New York, N. Y.; Chapman & Hall, London, England, 1950. Linen, 6 × 9¼ in., 80 pp., diagrams, charts, $2. This book instructs the author in the efficient preparation of manuscript and illustrations and explains the publishing procedure from the time the manuscript is submitted until the book is printed. The best and most economical methods of handling proof are described, and there is a glossary of terms.

BEST'S SAFETY DIRECTORY 1950-1951. Third edition. Alfred M. Best Company, New York, N. Y., Chicago, Ill., Cincinnati, Ohio, Boston, Mass., Dallas, Texas, Atlanta, Ga., Chattanooga, Tenn., Los Angeles, Calif., 1950. Fabrikoid, 8¼ × 11¼ in., 511 pp., illus., diagrams, $5. This directory contains classified listings of manufacturers of safety products and devices for every field of industry. Safety instructions and condensed classifications of equipment types precede the several sections, and precise definitions are given for the specific items listed in the directory. Among the changes in the new edition is the inclusion of a section on burglary protective equipment and alarm systems.

BIBLIOGRAPHY ON SPRAYS, Supplement No. 1 to edition of August, 1948. Compiled by K. J. De Juhasz and W. E. Meyer. Texas Company, Technical and Research Division, New York, N. Y., May, 1949. Paper, 8½ × 11 in., 22 pp. This pamphlet is the first supplement to the 1948 bibliography on liquid jets, sprays, and nozzles especially as used in oil-engine applications. It contains annotated references to articles written after the original work was published or written prior to the first edition, but not included in it.

CAR BUILDERS' CYCLOPEDIA OF AMERICAN PRACTICE, Eighteenth edition, 1949-1951. Compiled and edited for the Association of American Railroads, Mechanical Division; editors, C. B. Peck, C. L. Combes, and others. Simmons-Boardman Publishing Corporation, New York, N. Y., Fabrikoid, 8½ × 12 in., 1308 pp., illus., diagrams, charts, tables, $8. This standard reference work contains detailed descriptions and typical illustrations of all types of railroad and industrial cars, their parts and equipment; of shops and equipment employed in the construction and repair of cars; and of cars built in America for export to foreign countries. Detailed indexes to products, parts, and trade names are provided, and there is a 60-page dictionary of car terms.

CASTING OF BRASS AND BRONZE. By D. R. Hull. American Society for Metals, Cleveland, Ohio, 1950. Cloth, 6 × 9¼ in., 186 pp., illus, diagrams, tables, $3.50. This book considers some practical aspects of brass and bronze casting in America from 1900 to 1950. It is not only a record of personal experience, but also a discussion of the development of the casting process including numerous technological details which contribute materially to the quality of the product.

CHEMISTRY AND METALLURGY OF MISCELLANEOUS MATERIALS, Thermodynamics. (National Nuclear Energy Series, Division IV-19B.) Edited by L. L. Quill. McGraw-Hill Book Co. Inc., New York, N. Y.; Toronto, Canada; London, England, 1950. Cloth, 6 × 9¼ in. 329 pp., diagrams, charts, tables, $3. Of the important data selected for publication in the Nuclear Energy Series a considerable amount did not properly belong in any of the main subject fields. Of this miscellaneous chemical and metallurgical material the present volume contains the papers with important thermodynamic aspects. These papers include surveys on the thermodynamic properties of various elements and several of their compounds, surveys on the crystal chemistry of many materials, papers on geochemistry and on the chemistry and metallurgy of beryllium, and of the rare-earth elements, and so on. A separate volume is to contain the remainder of the miscellaneous chemical and metallurgical material.

DAVISON'S TEXTILE CATALOGUES AND BUYERS' GUIDE, November, 1949, edition. Davison Publishing Company, Ridgewood, New Jersey. Fabrikoid, 8½ × 11 in., 515 pp., illus., diagrams; free to textile plants; $12 to general public. A co-operative file of textile catalogs from manufacturers and distributors, this volume includes a buyers' guide with some 5000 separate classifications of machinery, supplies, chemicals, dyes, yarns, raw materials and services for textile plants. This edition contains descriptions of new machines, modern equipment, and numerous improvements in many devices, accessories, and supplies. Over 350 concerns are listed in this enlarged and revised edition.

DESIGNS FOR HELICOPTERS, SUPPLEMENT. By I. B. Laskowitz, author and publisher, 284 Eastern Parkway, Brooklyn 25, New York, N. Y., 1950. Paper, 8×11 in., 10 pp., diagrams, $2.50, inclusive price of original publication and supplement. The supplemental booklet contains the design for a jet-powered rotor helicopter with manual or automatic blade-pitch angle changing means, jet steering, and provision for additional forward thrust. The original booklet (1947) contains the design for a mechanical-powered rotor helicopter. Detailed descriptions are given with drawings.

ELEMENTS OF HEAT TRANSFER AND INSULATION. By M. Jakob and G. A. Hawkins. Second edition. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1950. Cloth, 6 × 9¼ in., 230 pp., illus., diagrams, charts, tables, $4. Although still restricted to basic principles and their applications, a number of somewhat more difficult methods and details have been added in the process of revision. Other changes of particular note are the expansion of the chapter on radiation, the insertion of graphical and numerical methods in the same chapters in which the corresponding analytical methods are presented, and the addition of a section on heat transfer and fluid friction on plane surfaces.

ENGINEERING ECONOMIC ANALYSIS. By C. E. Bullinger. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1950. Cloth, 6 × 9¼ in., 397 pp., diagrams, charts, tables, $4. The four main divisions of this text deal respectively with the following aspects of an engineering project: the economy analysis, concerned with the problem of yield on the investment; the financial analysis, dealing with the provision of funds; the analysis of intangibles, evaluating the factors in which human judgment is involved; and special methods and applications, as in the consideration of the economic characteristics of power-generating and power-using equipment. Tables and formulas for the necessary calculations are provided in appendixes.

EXPERIMENTAL DESIGNS. By W. G. Cochran and G. M. Cox. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1950. Cloth, 6 × 9¼ in., 454 pp., tables, $5.75. Experiments, to produce dependable results, must take into account all possible variables which might in-

troduce uncertainty. This guide describes in detail the most useful statistical designs which have been developed for this purpose, with accompanying plans and an account of the experimental situations for which each design is most suitable. A brief review of the basic theory of the analysis of variance is included with illustrative worked examples.

GEAR CUTTING PRACTICE. By F. H. Colvin and F. A. Stanley. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1950. Cloth, 6 × 9¼ in., 532 pp., illus., diagrams, charts, tables, $4.75. This particular book contains methods of handling all kinds of gear jobs, describes the various types of gears, and illustrates the setting up and operation of machines for producing them. In this third edition, the added material includes new data on carbide-tipped hobs, hobbing speeds, and feeds; new data on involute splines; new shaving and lapping methods of finishing gear teeth; and new inspection methods. It also discusses the latest methods of gear making and the latest information on the progress of gear making in general.

INDUSTRIAL INSPECTION METHODS. By L. C. Michelon. Revised edition. Harper & Brothers, New York, N. Y., 1950. Cloth, 6¼ × 9½ in., 566 pp., illus., diagrams, charts, tables, $6. Reflecting the growth in techniques, standardiazation, new devices, and statistical methods developed during the war, this book considers precision measurement as it is today. It provides a comprehensive and scientific presentation of the principles and current practices in industrial inspection work. As in the first edition, there are liberal use of illustrations, emphasis on standard terminology, and step-by-step presentation of good inspection practice. Statistical methods of quality control are covered.

INSPECTION ORGANIZATION AND METHODS. By J. E. Thompson. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1950. Linen 6 × 9¼ in., 369 pp., illus., diagrams, charts, tables, $5. Written from the management viewpoint, this book provides tested methods for improving efficiency, simplifying procedures, and reducing costs in inspection departments. Complete data necessary for the orderly planning, accomplishment, and recording of inspection examination and testing are supplied. Modern equipment and processes are discussed including the various methods of nondestructive testing. The appendixes contain typical inspection-job evaluations and inspection specifications.

MACRAE'S BLUE BOOK and Hendrick's Commercial Register. 57th annual edition, 1950. MacRae's Blue Book Co., Chicago, Ill. Linen, 8½ × 11¼ in., 3866 pp., illus., $15, foreign, $20. This annual reference volume lists all manufacturers in the United States under a detailed product classification. The listing under each product is alphabetical by company. A complete alphabetical listing of company names, with the capital ratings and local distributors, precedes the classified section. A 365-page trade-name index is included in the back of the volume.

MANUAL ON FATIGUE TESTING. (Special Technical Publication No. 91.) Prepared by American Society for Testing Materials, Committee E-9, Philadelphia, Pa., 1949. Paper and cloth, 6 × 9 in., 82 pp., diagrams, charts, tables; paper, $2.50; cloth, $3.15. Written by some of the leading authorities in this field, this manual provides information for those setting up new laboratory facilities, aids in the proper operation of the equipment, and offers advice on the presentation and interpretation of data.

MARKET FOR COLLEGE GRADUATES. By S. E. Harris. Harvard University Press, Cambridge, Mass., 1949. Cloth, 5½ × 8½ in., 207 pp., diagrams, charts, tables, $4. Proceeding on the premise that the number of college graduates is steadily outstripping the number of jobs available within the chosen professions, the author presents first a general survey of the problem and then a detailed analysis and documentation. The related aspects of education and income are discussed, and certain solutions are proposed for relieving the general situation and eliminating some of the special difficulties.

MEANING OF RELATIVITY. By A. Einstein. Third edition. Princeton University Press, Princeton, N. J., 1950. Linen, 5½ × 8 in., 150 pp., diagrams, charts, $2.50. This book contains the author's explanation of both the special and the general theories of relativity, including, in Appendix I, significant advances made since the original publication of the theory. Appendix II, added to this third edition, presents the new "generalized theory of gravitation," which attempts to interrelate all known physical phenomena.

PROBLEMS IN PERSONNEL ADMINISTRATION. By R. P. Calhoon. Harper & Brothers, New York, N. Y., 1949. Cloth, 5½ × 8½ in., 540 pp., tables, $5.50 regular trade edition; $4, college text edition. In contrast to the usual text on this subject which deals with techniques and practices, this book emphasizes problem analysis, problem handling, and actual administration of the various personnel functions. Among the topics treated are: work load and job assignment; writing and administering policies and procedures; problems of interpreting legislation; personnel administration and collective bargaining; and safety administration. Numerous problems, projects and demonstrations are included.

QUALITY CONTROL AND STATISTICAL METHODS. By E. M. Schrock. Reinhold Publishing Corporation, New York, N. Y., 1950. Cloth, 6 × 9¼ in., 213 pp., diagrams, charts, tables, $5. Intended for those who are new to the field, or relatively so, this book provides a logical approach to the effective appraisal and control of product quality. The basis and development of quality control charts are shown, and their use for and under various conditions is demonstrated both in the text and graphically. Acceptance sampling and sequential analysis are dealt with briefly in separate chapters. The methods given in the book have a wide range of industrial application.

ROYAL TECHNICAL COLLEGE JOURNAL, Vol. 5, Part 1, January, 1950. Royal Technical College, Glasgow, Scotland. Paper, 7¼ × 10¼ in., 279 pp., illus., diagrams, charts, tables, 21s. The first postwar volume of this record of research work contains a number of articles of special interest to engineers. Important topics discussed are lubrication problems, cavitation phenomena, the correlation of laboratory filter tests and rotary-vacuum filter performance, blast-furnace reactions, reactions of sulphur in steelmaking, the equilibrium constant of the reaction between molten iron and hydrogen sulphide, the elastic stability of thin-walled columns, friction tests on bearings, modern steam propelling units, and the combination of reciprocating machinery with an exhaust turbine.

SALES ENGINEERING. By B. Lester. Second edition. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1950. Linen, 5½ × 8½ in., 226 pp., diagrams, $3. Sales engineering is defined as the art of selling equipment and services which require engineering skill in their selection, application, and use. The author discusses the field of sales engineering, describes the work of the sales engineer under current conditions, and indicates the training and development of the sales enginer.

TABLES OF THE BINOMIAL PROBABILITY DISTRIBUTION. (Applied Mathematics, Series 6.) U. S. Bureau of Standards, Washington, D. C., 1949. Cloth, 8 × 10½ in., 387 pp., tables, $2.50. For sale by Superintendent of Documents, Government Printing Office, Washington 25, D. C. Continuing the Applied Mathematics Series, the current volume provides tables to seven decimal places of both individual terms and cumulative sums. The introduction explains the scope, method of preparation, interpolation procedure, and applications of the tables.

THERMODYNAMICS IN PHYSICAL METALLURGY. Seminar held during the 31st National Metal Congress and Exposition, Cleveland, October 15–21, 1949. Sponsored by American Society for Metals, Cleveland, Ohio, 1950. Fabrikoid, 6 × 9¼ in., 319 pp., illus., diagrams, charts, tables, $5. This book contains the papers presented at the third annual seminar of the Society which was held during October, 1949. The first seven lectures deal essentially with equilibrium phenomena. The following six lectures touch upon various essentially irreversible phenomena. The concluding paper considers the contribution of thermodynamics to metallurgical research and operations.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly, to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) At the succeeding Board meeting they are acted upon; (5) Those approved are sent to the inquirers and are published in MECHANICAL ENGINEERING. The following Case Interpretations were formulated at the Committee meeting April 28, 1950 and approved at the Board meeting June 23, 1950.

CASE No. 1100 (REOPENED)

(Special Ruling)

Inquiry: In view of the fact that Supplement No. 1—B16e-1939 was approved by the American Standards Association on April 27, 1949, may these revised ratings now be used in the design and construction of boilers and unfired pressure vessels?

Reply: It is the opinion of the Committee that Tables A, B, C, and D with their notes in Supplement No. 1—B16e6-1949 of B16e-1939 may be used to replace the corresponding parts of present Table A-9, "Service Pressure Ratings for Steel Pipe Flanges and Flanged Fittings" in the Power Boiler Code and Table UA-5, "Service Pressure Ratings for Steel Pipe Flanges and Flanged Fittings" in the Unfired Pressure Vessel Code, and that revised Table P-15 "Maximum Boiler Pressure for Use of American Steel Pipe Flanges, Fittings and Valves" may be used in place of present Table P-15. Minimum wall thickness of welding end valves shall be as given in Table E of ASA B16e6-1949.

CASE No. 1112

(Interpretation of Par. P-186)

Inquiry: Under Par. P-186(c) what distance may the furnace extend beyond the outside face of the tube sheet?

Reply: Where the end of the furnace is not protected by refractory material, the furnace shall not extend beyond the outside face of the tube sheet except as follows:

(a) If the furnace is attached by the flaring-welding method, the distance shall not exceed the thickness of the tube sheet. If a greater length to facilitate proper flaring is used, it shall be removed to that maximum before welding.

(b) If the furnace is attached by the full penetration weld method, it shall not extend beyond the toe of the weld and the toe of the weld shall not project more than $^3/_8$ in.

Errata

CASE No. 905

In the inquiry of the interpretation printed in MECHANICAL ENGINEERING, March, 1949, below chemical requirements, add:

Tensile Strength, lb per sq in....60,000 to 75,000

CASE No. 1002

At end of case change reference to "Table U-3" to "Table U-4"

CASE No. 1108

In the inquiry change reference to ASTM "B-169-48T" to "B-169-49T."

Cases Annulled

The following Cases have been annulled:

No. 935, No. 1051, and No. 1059

and should be so marked in Case Books and any references to them, as that to Case No. 935 in the Inquiry of Case 1074, should be deleted.

Proposed Revisions and Addenda to Boiler Construction Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code, to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennally the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [ ]. Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers 1949

TABLE P-5 Take the four lines for SA-53 now under Seamless Carbon Steel and insert them under Electric-Resistance Welded Carbon Steel. In their place under Seamless Carbon Steel repeat the four lines for SA-53 found in Table P-7.

PAR. P-112(a)(3) In first line change "outside diameter" to "nominal pipe size."

TABLE P-7 Add the following stresses for specification SA-182-49, Grade F-2 under Forgings Alloy Steel.

[beaded] and welded around the edge of the [bead] TUBE. [Where the tubes do not exceed $1^1/_2$ in. in diameter, the tube sheet may be chamfered or recessed to a depth at least equal to the thickness of the tubes and the tubes rolled into place and welded. In no case shall the tube end extend more than $^3/_8$ in. beyond the tube sheet.]

Tube ends [not subjected to direct radiant heat of the furnace may be rolled and seal welded without beading provided:] ATTACHED BY ROLLING AND WELDING ARE SUBJECT TO THE FOLLOWING PROVISIONS:

(1) The tube [ends extend not less than $^1/_4$ in., nor more than $^5/_{16}$ in., through the tube sheet;] SHEET HOLE MAY BE BEVELLED OR RECESSED TO A DEPTH AT LEAST EQUAL TO THE THICKNESS OF THE TUBES. WHERE THE HOLE IS BEVELLED OR RECESSED, THE PROJECTION OF THE TUBE BEYOND THE TUBE SHEET SHALL NOT EXCEED A DISTANCE EQUAL TO THE TUBE THICKNESS. THE DEPTH OF ANY BEVEL OR RECESS SHALL NOT BE LESS THAN THE TUBE THICKNESS NOR MORE THAN ONE-THIRD OF THE TUBE SHEET THICKNESS. [SEE FIG. P-31(f), (g).]

(2) [The throat of the seal weld is not less than $^3/_{16}$ in., nor more than $^5/_{16}$ in.;] WHERE NO BEVEL OR RECESS IS EMPLOYED THE TUBE SHALL EXTEND BEYOND THE TUBE SHEET NOT LESS THAN A DISTANCE EQUAL TO THE TUBE THICKNESS, NOR MORE THAN TWICE THE TUBE THICKNESS. [SEE FIG. P-31(e).]

(3) [After welding the tubes are re-expanded.] ON ALL TYPES OF WELDED ATTACHMENT THE TUBES SHALL BE ROLLED BEFORE WELDING AND AGAIN ROLLED LIGHTLY AFTER THE WELDING PROCEDURE.

(b) [In the case of tubes not exceeding $1^1/_2$ in. in diameter, they may be expanded by the prosser method in place of rolling. If tubes larger than $1^1/_2$ in. in diameter are expanded by the prosser method, the work shall be completed as required by (a).] EXPANDING OF TUBES BY THE PROSSER METHOD IN LIEU OF ROLLING MAY BE EMPLOYED IN COMBINATION WITH ANY BEADED OR WELDED ATTACHMENT METHOD.

(c) SEAL WELDING IS PERMISSIBLE ON ANY TYPE OF BEADED ATTACHMENT. WHERE SEAL WELDING IS EMPLOYED A SINGLE HYDROSTATIC TEST OF THE BOILER AFTER SEAL WELDING SHALL SUFFICE.

(d) THE INNER SURFACE OF THE TUBE HOLE IN ANY FORM OF ATTACHMENT MAY BE GROOVED OR CHAMFERED.

TABLE P-15 Delete the temperatures from the first column.

For metal temperatures not exceeding deg F

−20 to 650	700	750	800	850	900	950	1000	1050	1100	1150	1200
14000	14000	14000	13500	12000	10200	8000	5850	3850	2200	1400	900

NOTE: Allowable stresses for AISI Types 309(25-12), 309Cb(25-12Cb) and 310(25-20) temporarily will be the same as the stresses shown in Table P-7 for AISI Type 304. (SA-240 grade S).

PAR. P-250 Revise to read:

(a) A fire-tube boiler shall have the ends of the tubes firmly rolled and beaded, or rolled

PAR. P-311(b) Add as a second paragraph.

ONLY ONE BLOW-OFF VALVE, WHICH SHALL BE OF A SLOW-OPENING TYPE, IS REQUIRED ON FORCED-CIRCULATION BOILERS HAVING A NORMAL WATER CONTENT NOT EXCEEDING 100 GAL.

Unfired Pressure Vessels 1949

PAR. U-1(a) In twelfth line cross out "omitting the code symbol"

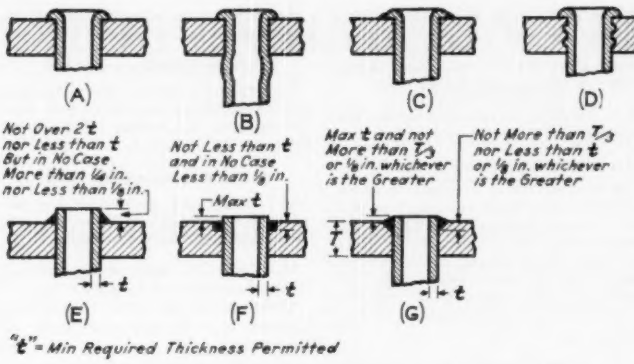


FIG. P-31 ACCEPTABLE FORMS OF TUBE ATTACHMENT ON FIRE-TUBE BOILERS

TABLE U-2 Under Forgings Alloy Steel add the stresses for Specification SA-182-49, Grade F-2 that are hereinbefore given for Table P-7. (For use in Table UG-23, the above stresses might be increased by using the multiplying factor 1.25.)

PAR. U-66(a) Revise third paragraph first sentence to read:

The stamping on the vessel shall consist of the ASME Code symbol [(shown in Fig. U-12)] SHOWN IN FIG. U-12 or for VESSELS CONSTRUCTED UNDER PAR. U-1(a)(1) AND (2) THE UM SYMBOL, the manufacturer's name, the manufacturer's serial number, the working pressure, and the year built, denoting that the vessel was constructed in accordance therewith.

Announcement

A new symbol stamp "UM" in a clover leaf for stamping on all those small unfired pressure vessels referred to in Par. U-1(a)(1) and (2) is now available.

Unfired Pressure Vessels 1950

PAR. U-1(d)(3) In second line cross out "gage."

PAR. U-1(e) In first line after "Unfired pressure vessels" insert "exempted by (d)." Revise eighth to tenth lines to read:

but such vessels NOT INCLUDED IN THE CLASSIFICATION OF (d) shall otherwise comply with the Code requirements and shall be marked with the data required in Par. UG-116, [omitting the Code symbol.] When requested,.....

PAR. UG-6(c) Delete Note.

PAR. UG-27(c) Revise to read:

Cylindrical Shells. When the thickness of the cylindrical shell does not exceed one half of the inside radius, OR P DOES NOT EXCEED 0.385 SE, the following formulas shall apply:

PAR. UG-27(d) Revise to read:

When the thickness of the cylindrical shell exceeds one half of the inside radius, OR P EXCEEDS 0.385 SE, the formulas given in Par. UA-2 shall be used.

PAR. UG-27(e) Revise to read:

Spherical Shells. When the thickness of the shell of a wholly spherical vessel does not exceed 0.356 R, OR P DOES NOT EXCEED 0.665 SE the following formulas shall apply:.....

PAR. UG-27(f) Revise to read:

When the thickness of the shell of a wholly spherical vessel does exceed 0.356 R, OR P DOES EXCEED 0.665 SE, the formulas given in Par. UA-3 shall be used.

PAR. UG-27(g) Add:

SEE NOTE 1 OF PAR. UG-31(c)

PAR. UG-27(h) Add:

SEE NOTE 1 OF PAR. UG-31(c)

PAR. UG-28(c) Revise to read:

Vessels intended for service under [partial vacuum or for an] external [working] pressure of [less than 15 psi] 15 PSI OR LESS, which are to be stamped with the Code symbol, [shall be designed for at least 15 psi external pressure corresponding to a collapsing pressure of 60 psi (See Par. U-1(d)(3))] DENOTING COMPLIANCE WITH THE RULES FOR EXTERNAL PRESSURE, SHALL BE DESIGNED FOR A MAXIMUM ALLOWABLE EXTERNAL PRESSURE OF 15 PSI OR 25 PER CENT MORE THAN THE MAXIMUM POSSIBLE EXTERNAL PRESSURE, WHICHEVER IS THE SMALLER.

NOTE: A VESSEL WHICH IS DESIGNED AND CONSTRUCTED TO CODE REQUIREMENTS FOR INTERNAL PRESSURE AND WHICH MAY AT TIMES BE SUBJECTED TO AN EXTERNAL PRESSURE OF 15 PSI OR LESS NEED NOT BE CONSTRUCTED TO CODE REQUIREMENTS FOR THE EXTERNAL PRESSURE CONDITION. SUCH A VESSEL MAY BEAR THE CODE SYMBOL FOR THE INTERNAL PRESSURE CONDITION.

PAR. UG-29(c) In last line change "stiffness" to "moment of inertia."

PAR. UG-32(g) In second paragraph, second line, change "a radius" to "an inside radius."

PAR. UG-32(r) Add the following:

(r) A HEAD FOR A CYLINDRICAL SHELL MAY BE BUILT UP OF SEVERAL SHAPES, EACH SHAPE DESIGNED TO HAVE ITS WALL THICKNESS AT LEAST AS THICK AS REQUIRED BY THE APPROPRIATE FORMULA ABOVE, PROVIDED THAT AT EACH JUNCTURE THE ADJOINING SHAPES ARE FORMED TO COINCIDE (HAVE COMMON TANGENTS TRANSVERSELY TO THE JOINT). FOR ABUTTING PLATE EDGES OF UNEQUAL THICKNESSES, THE TAPER REQUIRED BY PAR. UW-9(c) SHALL BE FIGURED TO LIE ENTIRELY WITHIN THE BOUNDARY OF THE SHAPE HAVING THE THINNER WALL.

PAR. UG-33(a) Revise last sentence to read:

Examples illustrating the application of the formulas in this paragraph are given in Par. UA-5 and Appendix L.

PAR. UG-36(c)(4) In first line after "(2)" cross out "and (3)."

PAR. UG-37(a) Revise last sentence to read:

For a circular opening IN A CYLINDRICAL SHELL the plane which [passes] CONTAINS [through] the axis of the shell [or head] is the plane of the [weakest section] GREATEST LOADING DUE TO PRESSURE.

PAR. UG-37(b) Revise definition of A to read:

A = TOTAL CROSS-SECTIONAL area [required to be replaced by] OF reinforcement REQUIRED in square inches, in the plane under consideration.

PAR. UG-37(d) Revise to read:

(d) *Design for Alternate Internal and External Pressure.* Reinforcement OF VESSELS SUBJECT TO ALTERNATE INTERNAL AND EXTERNAL PRESSURES shall meet the requirements of both (b) for internal pressure and (c) for external pressure.

PAR. UG-38(d) In second line after "flue" insert "and."

PAR. UG-43(a) Revise to read:

(a) *General.* PIPE OR NOZZLE NECKS MAY BE ATTACHED TO THE SHELL OR HEAD OF A VESSEL BY any of the methods of attachment given in this paragraph, except as limited in Par. UG-36. [may be used. Limitations are specified under each particular method.]

PAR. UG-43(f) In second paragraph, fifth line after "purposes" insert "such as."

PAR. UG-46(d) In seventh line change "surfaces" to "means."

PAR. UG-66 After last sentence add:

SEE PAR. UG-84(a).

PAR. UG-67 Add:

SEE PAR. UW-2(b)(2)]

PAR. UG-77(a) Revise first sentence to read:

[In laying out and cutting the] Plates for pressure parts PREFERABLY SHOULD BE LAID OUT SO THAT WHEN THE VESSEL IS COMPLETED, one complete set of the original identification markings required in the specifications for the material [used should preferably be plainly

visible when the vessel is completed] WILL BE PLAINLY VISIBLE.

PAR. UG-84(a) After last sentence add:
SEE PAR. UG-66.

PAR. UG-84(b) In sixth line after "(2)" add "and (3)."

PAR. UG-84(b)(3) Add the following paragraph:

(3) WHEN THERE ARE SEVERAL PRESSURE PARTS BEING WELDED IN SUCCESSION ON ANY ONE ORDER, THE PLATE THICKNESSES OF WHICH FALL WITHIN A RANGE OF $^1/_4$ INCH, WITH DIAMETERS DIFFERING NOT MORE THAN 6 INCHES AND OF THE SAME GRADE OF MATERIAL, A TEST PLATE SUBJECT TO THE REQUIREMENTS IN (1) SHALL BE FURNISHED FOR EACH 200 FT. OR FRACTION THEREOF, OF THE MAIN WELDED JOINTS.

PAR. UG-84(c)(5) In twelth line cross out "produced from the same."

PAR. UG-116(a)(1) revise to read:

(1) Official Code symbol shown in Fig. UG-116, (when inspected by the user's inspector as provided in Par. UG-91, the word "user" shall be marked above the Code symbol). ON VESSELS CONSTRUCTED UNDER PAR. U-1(e)(1) and (2) THE UM SYMBOL SHALL BE USED.

PAR. UG-127 In footnote 2, sixth line change "such" to "so" and in eighth line change "alternate" to "other."

PAR. UW-2(b)(2) Add:
SEE PAR. UG-67.

PAR. UW-10(a) In first line after "All vessels" insert "or vessel sections."

PAR. UW-10(d) In first line after "Vessels" insert "or vessel sections."

PAR. UW-10(e) In first line after "Vessels" insert "or vessel sections."

PAR. UW-10(h) Revise as follows:

The increased joint efficiency allowed in Table UW-12 for [a] stress [relieved] RELIEVING [vessel] may be used in design calculations [only] when the complete vessel is thermally stress-relieved [as prescribed in Par. UW-40] AND MAY ALSO BE USED IN DESIGN CALCULATIONS FOR VESSEL SECTIONS PROVIDED THE COMPLETE SECTION AND THE SEAM ATTACHING THE SECTION TO THE NEXT ADJOINING SECTION ARE THERMALLY STRESS-RELIEVED.

PAR. UW-11(c), (1) and (2) Revise as follows:

(1) All longitudinal and circumferential joints (INCLUDING THE JOINTS TO ADJOINING SECTIONS WHEN A VESSEL SECTION ONLY IS INVOLVED) are of the double-welded butt type, except nozzle and manhole attachment welds [to the shell] which need not be of the double-welded butt type; and

(2) All such double-welded butt joints (INCLUDING THE JOINTS TO ADJOINING SECTIONS WHEN A SECTION ONLY IS INVOLVED) are radiographically examined throughout their length as prescribed in Par. UW-51 except: . . . . .

FIG. UW-13(b) AND (c) Change "*Min. 1.3. t_s*" to "*Min. t_s*"

PAR. UW-14(b) In sixth line change "weld" to "thinner plate welded."

PAR. UW-15(a) In second paragraph, last line cross out "for lap type reinforcements."

PAR. UW-15(c)(3) Revise to read:

The minimum size of attachment welds for threaded connections not exceeding 3 in. pipe size, of which some acceptable designs are shown in Fig. UW-15(t) through (w), SHALL [need not] conform [to the] EITHER WITH THE minimum [values] REQUIREMENTS under this figure [but shall conform to (a) and Par. UG-41] OR WITH THE REQUIREMENTS OF PAR. UG-41.

PAR. UW-40(b)(3) On page 121 of the February printing of the 1950 Edition of Section VIII, the footnote [1] should be ahead of the table. It is correct in the earlier printing in which the pages were unnumbered.

PAR. UA-5(c) Revise second paragraph to read:

Example: Determine the maximum allowable working pressure for a conical head of the following dimensions:

$D = 200$ in.; $\alpha = 30$ deg; SA-285 Grade C [material] STEEL; maximum operating temperature = 300 F; $t = 1.00$ in.

$D_0 = 200 + 2 \times 1.00 \times \cos 30 = 201.7$ in.; $L = D = 200$ in.

$$\frac{L}{D_0} = \frac{200}{201.7} = 0.991 \qquad \frac{t}{D_0} = \frac{1.00}{201.7} = 0.00496$$

Entering the chart in Fig. UG-28.2 with $\frac{L}{D_0}$ and $\frac{t}{D_0}$, $P = 33$ psi, the maximum allowable external working pressure.

PAR. UA-6(b)(B) Make the first formula

(1) The thickness of the head, $t = \frac{5PL}{SE}$

and change present (1) to (2) and present (2) to (3).

PAR. UA-6(b)(D) Make the first formula

(1) The thickness of the head, $t = \frac{5PL}{SE}$

and make the flange thickness formula (2).

TABLE UA-47.2 Enter below right-hand sketch at bottom of page

FOR $b_0 = \leq {}^1/_4''$

and change ℄ nubbin to read

℄ GASKET CONTACT FACE

FIG. UA-48 is to be changed to agree with Fig. UA-3 of the 1946 Edition except that the dimensions g_0 and g_1 of sketch (1) are to be maintained. Sketch (2) will be redrawn according to Sketch (5) of Fig. UA-3 (1946).

TABLE UA-51, in definition of $B_1 = B + g_1$, change reference at end from "Fig. UA-51.4" to "Fig. UA-51.6."

PAR. UA-51 In both formulas over Fig. 51.5 change "g_0" to "g_0^2."

FIG. UA-51.1 In numerator of formula for U change $\log_{10}K^2$ to $\log_{10}K$.

Welding Qualifications 1949

TABLE Q-5 Transfer references to Specifications SA-300, SA-301, and SA-302 from Table "P" Number 1–"O" Number 1 to Table "P" Number 4–"O" Number 1.

Material Specifications 1949

SA-7 Delete this specification and substitute A-107 (Grades 1010 through 1030) for bars and A-307 Grade B for bolting.

SA-217 PAR. 10 Make stresses for grade WC-1 the same as those for grade WC-2.

SA-266 Revise line under title to read: (IDENTICAL WITH ASTM A-266-49T EXCEPT FOR PAR. 10.)

SA-266 PAR. 10 Revise last sentence to read:

IN THE CASES OF CLASSES I AND III the chemical composition thus determined shall conform to the requirements specified in Par. 8 IN THE CASE OF CLASS II FORGINGS THE CHEMICAL COMPOSITION THUS DETERMINED SHALL NOT VARY FROM THE REQUIREMENTS PRESCRIBED IN TABLE I.

EDITORIAL NOTE

Since Material Specifications 1949 went to press the American Society of Testing Materials has brought out 1949 revisions of many of its specifications. A few have editorial changes only but most have significant changes. All changes will appear in the next Addenda to Material Specifications, but are too extensive to print in MECHANICAL ENGINEERING. Meantime, the following list of specifications that have been revised will enable ordering needed copies from ASTM:

Plates		*Editorial Changes*
SA-30	SA-225	SA-129
SA-182	SA-240	SA-202
SA-201	SA-285	SA-300
SA-203	SA-299	
SA-204	SA-301	
SA-212	SA-302	

Castings	*Editorial Changes*
SA-217	SA-48

Tubular Products

SA-158

Forgings	*Editorial Changes*
	SA-194
SA-181	
SA-182	
SA-193	
SA-320	

Nonferrous

SB-11	SB-61	SB-111	SB-163	SB-168
SB-12	SB-62	SB-127	SB-164	SB-171
SB-13	SB-75	SB-160	SB-165	SB-178
SB-42	SB-96	SB-161	SB-166	
SB-43	SB-98	SB-162	SB-167	

THE ENGINEERING PROFESSION

News and Notes

As Compiled and Edited by A. F. Bochenek

Impostor Claims ASME Membership

FALSE claims to ASME membership and faked documents bearing the ASME name have recently been used by Frank Alden Miller of Buffalo, New York, to deceive persons into employing him at excessive salaries and investing in various mechanical devices on the strength of a professional standing and history he invented for himself, it was revealed by The American Society of Mechanical Engineers, following a recent investigation into Mr. Miller's activities.

Mr. Miller is not a member of the ASME and never has been. But in at least two instances, disclosed to the ASME, he claimed long-term membership in the ASME and friendship and influence with persons high in that organization in order to obtain employment as an engineer. He supplemented these representations with spurious test reports from nonexistent ASME testing laboratories on the commercial potentialities of several mechanical devices he owned, or claimed to own, and thereby induced his employer and others to invest in their development and promotion.

Mr. Miller carried on both ends of a voluminous correspondence with imaginary ASME officials, wrote technical reports capable of deceiving an experienced machine-tool man and, according to the documents he fabricated, played a lively role in the activities of the Society and in public matters with which the Society is connected. As part of the scheme, he used several kinds of stationery bearing ASME letterheads and an ASME meeting program with his name listed among the speakers. These were not authentic. Mr. Miller apparently had them printed himself.

Mr. Miller's employers, who did not think to check his claims with the ASME and did not know that the ASME does not operate testing laboratories, were convinced that he was an engineer of the highest standing and were induced to spend large sums of money on the basis of the misrepresentations he made and the papers he fabricated.

The investigators who looked into the facts concerning Miller's activities for the ASME believe that he may try the same scheme again.

Members are asked to notify the Secretary of any evidence that Mr. Miller is continuing to pose as an ASME member.

Engineering Unity Conference Releases First Progress Report

Three Approaches to Unity Favored

THE following is the first official report on progress of an Engineering Unity Conference which has been at work since October, 1949, on an approach to unity in the engineering profession. All meetings have been closed to the public. While the conference was initiated by the Engineers Joint Council, EJC is not one of the participating organizations nor has it any connection with or responsibility for its deliberations.

The group of representatives of large engineering societies, invited by Engineers Joint Council to explore the question of organization for increased unity of the engineering profession, had its second meeting on March 31, 1950. This group consists of the following 16 engineering societies:

American Society of Civil Engineers; American Institute of Mining and Metallurgical Engineers; The American Society of Mechanical Engineers; American Institute of Electrical Engineers; American Institute of Chemical Engineers; American Association of Engineers; American Society for Engineering Education; American Society of Heating and Ventilating Engineers; American Society of Refrigeration Engineers; American Water Works Association; Illuminating Engineering Society; Institute of the Aeronautical Sciences; Institute of Radio Engineers; National Society of Professional Engineers; Society of Automotive Engineers; and Society of Naval Architects and Marine Engineers.

Fourteen of the sixteen societies were represented at the recent meeting.

The major order of business was the consideration of the report of the Planning Committee of eight members which was appointed at the previous meeting of the Exploratory Group on Oct. 20, 1949. The Planning Committee had been charged with the duty of studying and reporting back a discussion of various approaches which had been suggested to the question of organizing for increased unity.

The Planning Committee had held five meetings at which the wide range of subjects involved in the question at hand had been discussed. The report of the Committee submitted at this meeting included a discussion and comparative analysis of three possible approaches to the formation of a unity organization.

Many Approaches Being Studied

Recognizing that many approaches are possible, the report of the Planning Committee included also suggestions as to a number of basic principles which were recommended to serve as a guide in any formation of a "unity organization" of engineers—this term being used to designate the organization through which increased unity of the engineering profession may be brought about, without in any sense proposing that this be adopted as a name of such an organization. The basic principles include the following:

The general aim of the unity organization will be to represent all engineers and engineering organizations who desire to be so represented in dealing with questions of interest to the profession as a whole. With this general aim in view, the following are proposed as basic principles to serve as a guide in determining the form of the unity organization and in its relation to present engineering organizations.

(1) The unity organization should include the affiliation of the major national engineering societies.

(2) Affiliation should be open to all national engineering societies meeting certain general standards, on vote of the governing body. As illustrative of the type of standards which may be established, it may be required that to qualify as an affiliate an engineering society should have a grade of membership with qualifications at least as high as those prescribed by the unity organization as necessary for professional recognition. Also, as a practical matter, affiliation may be limited to societies having more than a specified minimum number of members who are qualified engineers in accordance with this definition.

(3) The unity organization should be formed by the modification and development of a present organization or organizations or by the integration of two or more present organizations rather than by the establishment of an entirely new organization.

(4) The government of the unity organization should reside in a governing body on which all qualified engineering groups who wish to be associated with the organization are appropriately represented.

(5) The activities of the unity organization should be determined by the governing body under the terms of a broad statement of general purposes in the constitution of the or-

ganization. While a fairly complete statement of the general purposes of the organization should appear in its constitution, it does not appear useful to attempt to determine in advance what its specific activities would be at any given time. These would, no doubt, change from time to time in accordance with the wishes of the members.

(6) Within its field of activity, the unity organization should be authorized to deal directly with government agencies and others as a representative of the engineering profession. For example, in such matters as the nomination of engineers to serve as members of committees and commissions, or the expression of opinions on public questions involving engineering, the unity organization should be empowered to act directly without a referendum of its constituents.

(7) To the extent practicable, the unit organization should take over present co-operative activities of groups of national engineering societies, where such activities appropriately fall within the scope of the unity organization.

(8) The unity organization should have its own offices and staff.

These principles were accepted by the Exploratory Group subject to such modifications as might be arrived at in further discussions. The report of the Planning Committee also presented a number of other questions requiring further consideration.

Most Favored Plans

In the general discussion of the Exploratory Group, every member presented his views as to the type and form of "unity organization" which seemed most desirable and the means by which it might be brought about. The discussion centered about the three approaches to the form of organization included in the report of the Planning Committee. These three approaches would be as follows:

(*A*) Expand and modify the present Engineers Joint Council so that the members of a larger number of engineering societies would be represented and so that representation would be, to some extent, in proportion to membership.

(*B*) Expand and modify the present National Society of Professional Engineers with the understanding that the existing engineering societies co-operate by urging their members to join and by referring to that Society items of a broad general nature which the Society is in a position to handle.

(*C*) Modify the National Society of Professional Engineers so that registration is not a requirement for individual membership, modify the Engineers Joint Council as in Item *A*, and combine the NSPE Board of Directors with the EJC to form a single governing body.

After a full discussion the entire matter of preparing a further comparison of possible plans and a consideration of the questions on which agreement had not been reached was referred to the Planning Committee for study. It is expected that the next report of the Planning Committee will be made to the Exploratory Group shortly after the summer vacation period.

More Engineers Needed in Top Management

ENGINEERS should take a more active part in management—not only in engineering design, production, and general management, but also in top executive positions, including those of vice-president and president. This opinion and many others touching on the basic nature of engineering and industry and the duties of industry to engineering education were expressed by E. G. Bailey, Honorary Member and past-president, ASME, at the ASEE Industry College Conference, Swarthmore College, Swarthmore, Pa., March 25, 1950, and the Engineer's Day ceremonies, University of Denver, Denver, Colo., April 27, 1950.

Mr. Bailey listed the three basic requirements of industry as finance, management, and a useful product; but he claimed the product was the basic factor. "Neither finance nor management alone," he said, "can keep an industrial company out of bankruptcy." Men trained in basic engineering were needed at the top.

Strength From Within

Referring to the continuity of industrial enterprises, Mr. Bailey stated that every organization is self-corrective or self-destructive. It was his opinion that to maintain a healthy growth, management of industry must come from within, from men who have full knowledge of its basic foundation, which is its production. An enterprise to survive must be keenly alive to its competition. It must keep abreast of progress likely to be made in allied and related industries as well as in existing and potential markets. But above all, Mr. Bailey continued, industry must depend largely on the educated engineer and his practical experience.

Use Statistics Wisely

Referring to the U. S. Department of Labor's booklet "Employment Outlook for Engineers," which painted a dismal picture of 18,000 job opportunities in 1950 for a graduating class of 50,000 engineers, Mr. Bailey cautioned engineers to use statistics wisely and to accept them for what they are worth.

It was his opinion, he said, that the country needed more engineers today than at any time in its history. He substantiated this opinion by referring to the 1949 survey of the Engineers Joint Council which indicated a total demand for 25,000 engineering graduates. Later in 1949, when a survey of actual placements was made, it was found that about 37,000 engineers had found employment, or about 50 per cent more than originally indicated. A large part of the unpredicted employment, he said, was undoubtedly with a large number of small companies which were not included in the EJC survey. Many small companies, he said, were now employing the engineering graduates whose employment was deferred shortly after the war because of the shortage of technically trained men. There was evidence, also, that engineers were recognizing that small companies offer opportunities that are often more promising than those offered by large companies.

Danger of Opportunism

Expressing skepticism over the value of humanistic social courses in the engineering schools which can overload the engineering curriculum, Mr. Bailey cautioned that engineering education should not take the easy path which could make politicians and opportunists of our engineering graduates. Engineers should be able to work with their hands and should have experience doing so, otherwise, he declared, they would not be fully qualified to guide workers or to invent and develop new methods, processes, or devices.

The Engineering Profession in New Zealand

THE economic status of engineers in New Zealand is the principal concern of the Professional Engineers Association of New Zealand. Organized in 1943, it includes among its members 950 professional engineers whose professional attainments are on the level of the corporate members of The Institution of Mechanical Engineers and the other engineering institutions of Great Britain.

The Association is divided into seven professional divisions on a dominion-wide basis, and into fourteen geographical branches.

In improving the economic status of its members the Association is in continual discussion with individual employers over such things as the engineer's salary, his conditions of employment, his authority in his job, relationship of other administrative officers, and other matters of status which the individual cannot always maintain unaided. New Zealand also has a registration act which protects the title "registered engineer" for engineers registered by the state. Qualifications for registration are equivalent to that of member ASME. Engineers in private industry are not obliged to be registered. The Act applies principally to engineers in civil service but states that all engineering work performed by local authorities, financed by loans or expenditure of a sum of approximately $30,000, must be carried on by registered engineers.

The Association has formulated a code of ethics and a standard scale of fees for consultants.

As in Canada, the engineering organization which devotes itself to the advancement of engineering is an over-all organization combining civil, electrical, and mechanical engineering known as the New Zealand Institution of Engineers.

EJC Water-Policy Panel Proposes Board for Impartial Analysis

250-Page Report Contributed as Public Service

The engineering profession, working through the Engineer's Joint Council, spoke out bluntly last month against "excessive and unsound" water-resources practices which it attributed to competing federal agencies and Congressional "response to pressure and trading," and called for a halt in further authorizations until uniform national water policy has been adopted.

In a sharply worded 250-page report differing drastically from the customary scientific language of the profession, an 80-man EJC Committee suggested specific remedies and pointedly reminded President Truman, his Water Resources Policy Commission, and "both political parties" that "public money is limited in availability."

In presenting the report to the President and the Commission, the engineers condemned "political expediency" tactics and "exaggeration of benefits claimed" and warned that unless the "degradation" of the last two decades in the "application of criteria to water-resources development" is halted, "estimates of benefits will soon become mere excuses for justification, not valid reasons for construction of projects." Copies of the report may be obtained from the Engineers Joint Council, 29 West 39th Street, New York, 18, N. Y. Price is $1.50.

EJC Represents 100,000 Engineers

Engineers Joint Council is an organization of the five national engineering societies: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers. In matters of common interest, the Council is the clearinghouse for these organizations whose membership totals more than 100,000. The report was submitted at the July 1, 1950, deadline set for it by the President's Commission. It was termed by EJC a "service rendered by the profession to the public" and was likened to two similarly prepared professionwide studies on disarmament of Germany and Japan, which were published early in the postwar period.

Nine task forces made the study (see May issue of Mechanical Engineering, page 435), the report on which deplored "ambiguous, unco-ordinated, and conflicting" federal policies covering power, irrigation, flood control, navigation, and other water-resources projects. Warning that "evaluation of project is a first requirement," the report attacked boondoggling and logrolling in stressing such items as local responsibility, need for equitable allocation of costs, and fallacy of "incentive payments" to landowners for soil-conservation measures, among others.

Excerpts of other criticisms follow:

"A number of inland-waterways projects are in existence today that are completely devoid of any justification.

"The use of inland waterways as a regulatory agency to force reductions in rates on land carriers should be abandoned.

"Many immediate beneficiaries pay little or nothing toward the costs of projects. There is a progressive trend toward shifting the burden onto those who bear the expense of government through taxation. Unless the development of water resources is to be permitted to degenerate into the diversion of the national income for the benefit of particular regions or classes of people for political expediency, there must be a reversal of the present trend and acceptance of obligations.

"The public-utility form of contract authorized by the Reclamation Projects Act of 1939 can be made workable and acceptable. It requires only that the Bureau of Reclamation shall recognize the obligations of public-utility service and not use such contracts to implement social changes."

Overlapping Agencies

Although the report did not direct itself to the activities of any particular agency, it cited the fact that the Department of the Interior, Corps of Engineers, Department of Agriculture, Federal Power Commission, U. S. Public Health Service, Weather Bureau, Coast and Geodetic Survey, and many others are concerned with one phase or another of water development. As the number of federal agencies involved has grown and "as these have risen in stature their overlapping functions have become increasingly striking and their competitions have become impressively expensive," the report asserted, in describing the current situation as "chaotic." Haphazard development of vital water resources was denounced by the engineers, who especially decried projects developed and constructed, and often operated, by the agency originating them.

Board for Impartial Analysis Proposed

To alleviate competition between agencies which, the report asserted, is fostered by this practice, and to safeguard the public against exaggerated intangible benefits claims as well as improper allocation of costs between general taxpayers and project beneficiaries, the report recommended creation of a board for the impartial analysis and appraisal of all federal water projects. Such a board, the report pointed out, would also serve to protect the public against "the present excessive and economically unsound rate of planning and Congressional authorizing of developments," since the board's review and report would be "prerequisite to the authorization or appropriation by Congress of or for projects of that kind."

In support of their proposal that engineers without continuing interest in the projects be utilized to determine economic justifiability of dams and reservoirs built for flood control, irrigation, navigation, and power, and any combination of these services, the EJC report pointed out that today's water developments have reached a level "representing billions of dollars annually instead of the millions per year of the period prior to 1930." As an example of the pyramiding impact of current federal policy, the report cited the fact that, "as of 1948, federal water-development projects then under construction involved an expenditure of funds greater than those expended for all projects in all the years preceding June 30, 1947—approximately $5,000,000,000. At the same time, projects not yet under construction but already proposed by federal agencies will require about four times the amount now being expended for projects under construction."

Local Development Favored

Urging that water-resources development "should, wherever feasible, be by local enterprise—governmental or private," the committee warned:

"Collective action through the medium of the federal Government is justified only for two purposes—to do those things essential to national defense or otherwise of substantial benefit to all the people throughout the nation, or to aid in financing construction cost of works for the benefit of a limited number of people on terms equitable to all other citizens of the nation."

In the first function, the engineers reminded the government, it is acting as trustee in disbursing tax revenues and should obtain the greatest benefits to the nation as a whole. This, the report said, "requires a determination of what is best, not merely what is good." The second function makes the government a banker "responsible for the soundness of his loans," the engineers said, with responsibility for seeing to it "that the period of amortization should not exceed the useful life of the works."

Other recommendations included:

Authorization of federal water projects should be solely by Congress.

There should be no further authorization until uniform national policy has been adopted.

So far as practicable, projects should be self-supporting.

Authorizations should serve as an absolute limit on appropriations and should not be in blanket form.

The Congress should review any substantial change in project, and authorizations should become void if the project cost overruns by 20 per cent the cost estimated at time of authorization.

Policy of general applicability for use in connection with all functions of federal water-resources development should be prescribed for use by all agencies.

Adequate time should be allowed for collection of essential data and for determination of whether there is real need for a proposed development.

Expenditures should be at a lower rate during periods of general prosperity and at a greater rate during periods of reduced business activity and employment.

Benefits should be expressed in average an-

nual monetary terms and strictly compared with average annual costs.

The Government, "and hence the nation's taxpayers," should be reimbursed by beneficiaries for benefits accruing directly to them. Where there is subsidization, "there should be complete disclosure in all details, beginning with the initial reports recommending the development for authorization by Congress" and all subsequent reports, including annual reports, should be equally revealing.

Appraisal of costs should be realistic, as should the distinction between estimates and actual expenditures.

The charge made for use of money should cover all aspects of all such costs.

Computation of costs of federal developments for "determining economic justification or for any other purpose" should include amounts equivalent to the taxes which would have to be paid were the lands, physical improvements, and business not exempt from taxation, whether federal, state, or local. Also, so far as practicable, lands and rights subject to taxation when acquired by the United States for such developments "should continue to be subject to the same requirements of taxes at the same rates, and actually pay such." In cases of federal revenue-producing developments, "the principle should be extended to provide for the payment of State and federal income and excise taxes or their full equivalents."

Standard criteria of economic justification were spelled out to be used as yardsticks for measuring, and from time to time "realistically" reappraising benefits and costs and the division of the latter on multiple-purpose projects.

No engineers now actively engaged under the federal services served on the engineers' committee, the report stated; but experience within the federal services is well represented, about one third of the membership at some time having had actual experience there. Engineers Joint Council asserted in the report that the statement will be expanded at a later date "to cover matters not possible of inclusion under the original effort and to provide further documentation."

Manual on Public Speaking Prepared for Engineers

USEFUL information on how to make engineering meetings more interesting by improving delivery and platform manners of speakers and meeting chairmen has been incorporated in a pocket-size manual "Speaking Can Be Easy for Engineers," by a committee of the Relations With Industry Division of the American Society for Engineering Education.

In the interest of better engineering meetings, the booklet is being sponsored by the Engineers' Council for Professional Development. The manual, which can be read in 30 minutes, is illustrated in a humorous vein to emphasize the main points. The text has been arranged to enable a reader to cover the most important points throughout the manual in about five minutes. Check lists for both speaker and meeting chairman are provided to help engineers improve their execution of these important functions. For a prospective speaker the manual offers subjects on the type of speech to select, hints on planning and preparation, attention patterns, tips on platform manner, and microphone technique.

For the chairman, the manual has a section on effective introductions, suggestions for starting and handling questions, and other tested devices for assuring larger and better audiences.

The manual is the work of Erhardt C. Koerper, Jun. Mem. ASME, research consultant, A. O. Smith Corporation, who is editor; J. L. Singleton, vice-president, Allis-Chalmers Manufacturing Company; L. J. Fletcher, Mem. ASME, director of training and community relations, Caterpiller Tractor Company; S. D. Kirkpatrick, vice-president, McGraw-Hill Publishing Company, Inc.; Westbrook Steele, director, Institute of Paper Chemistry; and Ward Delaney, president, Institute of Textile Technology. In addition to the work of these men and their associates, the various drafts of the manuscript have been reviewed by numerous well-known speech coaches and public-relations authorities.

Copies may be obtained from ECPD, 29 West 39th Street, New York 18, N. Y. Price per copy is 50 cents.

Plow Bolts

TWO new plow-bolt designs are recommended in a new American Standard for plow bolts (ASA B18.9-1950) published by The American Society of Mechanical Engineers. The standard is intended to reduce the number of plow-bolt sizes now in use and to facilitate production and availability of stocks of standard sizes without stocking quantities of special bolts.

Recommended bolts are the No. 3 square neck, 80-deg round countersunk head, and the No. 7 reverse key, 60-deg round countersunk-head plow bolts. Standards for No. 3 square neck, countersunk repair head; No. 4 countersunk, square repair head; No. 6 heavy key, round countersunk repair head; and No. 7 reverse key, round countersunk repair head for service purposes are included.

Specifications for nine sizes of No. 3 square neck, 80-deg round countersunk-head plow bolts from $^5/_{16}$ to 1 inch diameter, and for seven sizes of No. 7 reverse key, 60-deg round countersunk-head plow bolts from $^5/_{16}$ to $^3/_4$ inch diameter are tabulated. For the convenience of designers the new standard gives features of the new head designs to be considered in their utilization. Price per copy is 55 cents.

Industry Absorbing Record Engineering Class

THE publicized shortage of jobs for 1950 June engineering graduates has not materialized in spite of the largest graduating class in the history of American engineering education, M. M. Boring, Mem. ASME, and chairman of the General Survey Committee of the Engineers Joint Council, told members of the American Society for Engineering Education at its annual meeting at the University of Washington in June. In fact, four out of five 1950 June graduates had accepted jobs or received job offers within three weeks of their commencement.

"There is much evidence," Mr. Boring said, "that if we have a small enrollment in freshman classes entering from high schools this fall, we shall clearly face a serious shortage of engineering graduates four years from now."

Survey of 117 Colleges

Mr. Boring's remarks were based on a telegraphic survey of 117 engineering colleges throughout the country conducted by the Manpower Committee of the American Society for Engineering Education, under the chairmanship of Dean L. M. K. Boelter, of the University of California at Los Angeles. The results showed that 62.5 per cent of all engineering graduates this year were placed by June 18 and an estimated 20 per cent more had received job offers but as yet had made no commitments.

A similar survey in 1949 showed that 62 per cent of the graduating seniors were placed by July 1 of that year. Then placement continued throughout the summer months and by November nearly 95 per cent of the previous June graduates reported placement. Many others presumably failed to report jobs which they had accepted.

Outlook for 1951 Favorable

The outlook for the 35,000 engineers who will be graduated in 1951 is considered favorable. Even fewer are expected to be graduated in 1952 and 1953, but there is no reason to expect declining demand if the present high level of industrial activity is maintained, ASEE officials believe a shortage of engineering graduates may be "acute" by 1953, they said.

"Considerable publicity has been released during the past few months regarding the possibility of an oversupply of engineering graduates," Mr. Boring noted, and he deplored the effect which this has apparently had in reducing the expected enrollment of young men from high schools to the engineering colleges this fall.

* * *

JOB opportunities in the Territory of Hawaii for recent engineering graduates are "not too bright" according to Marsh W. Bull, secretary-treasurer, Engineering Association of Hawaii, Honolulu, T. H. The Association was organized first as the Hawaiian Engineering Association and later as the Honolulu chapter of the American Association of Engineers, and in 1925 became an independent group under its present name. The Association sponsors a weekly bulletin and is active in civic affairs. Recent speakers discussed municipal construction programs and development of national resources of the Territory.

1950 Power Show to Be Better Than Ever

NEW developments in the field of power will be presented at the 19th National Exposition of Power and Mechanical Engineering in Grand Central Palace, New York, N. Y., Nov. 27 to Dec. 2, 1950. The Power Show, as it is generally known, will be held under the auspices of The American Society of Mechanical Engineers in conjunction with the ASME Annual Meeting.

Industrial executives and power-plant operators visiting the exposition will have opportunity to see the newest products all under one roof and to observe them in operation. They will be in contact with thousands of engineers and others in a position to help them with problems of greater plant efficiency, lower production costs, and others affecting their business.

The Advisory Committee for the exposition has recently been announced. Irving E. Moultrop, Honorary Member, ASME, Boston, Mass., again is chairman of the committee, and John H. Lawrence, Fellow ASME, New York, N. Y., is vice-chairman. Both Mr Moultrop and Mr. Lawrence are consulting engineers widely known in their field. Mr. Moultrop is an honorary member of the Boiler Code Committee of The American Society of Mechanical Engineers, and Mr. Lawrence is vice-chairman of the Finance Committee of the Society.

Other members of the committee include: Lester T. Avery, president, American Society of Heating and Ventilating Engineers; John G. Bergdoll, Jr., president of American Society of Refrigerating Engineers; James D. Cunningham, president ASME; C. E. Davies, secretary, ASME; Chester R. Earle, managing editor, *Power Engineering;* David Moffat Myers, consulting engineer; Joseph Pope, vice-president, Stone and Webster Engineering Corporation; L. N. Rowley, Jr., chairman of the Board on Technology, The American Society of Mechanical Engineers; Ralph A. Sherman, director at large, ASME; A. Bowman Snavely, chief engineer, Hershey Chocolate Corporation; Philip W. Swain, editor, *Power;* and Willis F. Thompson, vice-president, Westcott & Mapes, Inc.

The exposition is under the management of the International Exposition Company, of which Charles F. Roth is president.

U. S. Applied Mechanics Congress Planned for 1951

THE first United States National Congress of Applied Mechanics will be held in Chicago, Ill., June 11-16, 1951, it was announced recently by the U. S. National Committee on Theoretical and Applied Mechanics. The Committee is composed of representatives of the following organizations: American Institute of Chemical Engineers, American Society of Civil Engineers, The American Society of Mechanical Engineers, American Mathematical Society, American Physical Society, Institute of Aeronautical Sciences, Society for Experimental Stress Analysis, Illinois Institute of Technology, Purdue University, Northwestern University, and University of Illinois.

It is planned that the United States National Congress will be a regular event in the applied-mechanics field held every four years in the interim between the International Congresses of Applied Mechanics, the next session of which will be held in Istanbul, Turkey, in 1952. The U. S. Congresses will be similar to the International Congresses and will be planned to supplement rather than to compete with them. No attempt will be made to attract participation by workers outside the United States and Canada although there will be no rule against such participation.

All workers in the field are cordially invited to submit papers for the first National Congress. Papers should constitute original research in applied mechanics, which include kinematics, dynamics, vibrations, waves; mechanical properties of materials and failure; stress analysis, elasticity, plasticity; fluid mechanics; and thermodynamics. Papers must not exceed 5000 words or the equivalent in equations, tables, and diagrams. It is intended that all papers accepted by the Editorial Committee, with the advice of recognized authorities in the respective field of interest, will be published in full in bound and printed proceedings of the Congress. Proceedings are to appear within the year.

To be considered for presentation, abstracts of papers must be submitted to Eli Sternberg, chairman, Editorial Committee, Illinois Institute of Technology, Technology Center, Chicago 16, Ill., before April 14, 1951, and the full manuscript submitted prior to June 11, 1951.

Technical sessions, social events, lectures, and demonstrations will be included in the Congress program. For further information write to N. M. Newmark, University of Illinois, Urbana, Ill.

Meetings of Other Societies

Aug. 14-18

National Association of Power Engineers, Inc., national convention, Hotel Jefferson, St. Louis, Mo.

Aug. 28-31

American Mining Congress, metal mining convention and exposition, Utah State Fair Grounds, Salt Lake City, Utah

Sept. 4-8

American Chemical Society, 118th national meeting, Chicago, Ill.

Sept. 8-9

Brown University, 3rd symposium on plasticity, Brown University, Providence, R. I.

Sept. 18-22

Instrument Society of America, national instrument conference and exhibit, Municipal Auditorium, Buffalo, N. Y.

Sept. 26-29

Association of Iron and Steel Engineers, annual convention, Hotel Statler and Cleveland Public Auditorium, Cleveland, Ohio

Sept. 27-30

Society of Automotive Engineers, Inc., aeronautic meeting and aircraft engineering display, The Biltmore Hotel, Los Angeles, Calif.

(*For ASME Calendar of Coming Events see page 690*)

People

ASME Elects Three Fellows

THE American Society of Mechanical Engineers has honored three of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and has been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who, by virtue of their contribution to their profession and to the Society, were so honored are:

Joseph Henry Keenan

Joseph H. Keenan, professor, mechanical engineering, Massachusetts Institute of Technology, was born in Wilkes-Barre, Pa., Aug. 24, 1900. In 1922 he was graduated from M.I.T. with an BSME degree. Professor Keenan's work in the development of the tables of the properties of steam, initially under the direction of Harvey N. Davis in 1923, while in the employ of the General Electric Company, and later his work in association with F. G. Keyes on the tables of the properties of air and of other gases, and his book on thermodynamics constitute notable engineering achievement. His work with G. B. Warren on the testing of steam-turbine nozzles is regarded highly. As assistant professor at Stevens Institute of Technology from 1928–1934 and since 1934 his work at M.I.T. has likewise been outstanding, because of his ability in developing able graduate students and junior staff members. He holds patents on processing equipment and his "Keenan Collector" is a definite contribution to the economic control of atmospheric pollution. He is the author of "Steam Tables and Mollier Diagram" and "Thermodynamics"; coauthor of "Thermodynamic Properties of Steam," "Thermodynamic Properties of Air," and "Gas Tables"; and author of numerous papers relating to steam research, fluid mechanics, and thermodynamics.

Roy Hiram Porter

Roy H. Porter, assistant to general manager of mines, New Jersey Zinc Company, was born in South Paris, Me., Nov. 16, 1883.

He received a BSME degree, University of Maine, 1906; ME, Iowa State College, 1912. From 1906–1915 he was successively, instructor, assistant professor, and associate professor of mechanical engineering at Iowa State College, Ames, Iowa. In 1915 he went to New Hampshire State College as professor of mechanical engineering, where, in addition to his regular teaching duties, he designed a pumping system for potable water from deep wells.

In 1918 he joined the New Jersey Zinc Company. Among his accomplishments with this company were the improved maintenance techniques, developments in maintenance operation, and cost controls. During World War II Mr. Porter was called to act as consultant to the assistant general manager of mines in meeting all mechanical problems associated with the operations of the company's mining properties.

He has been active in the ASME student branch movement and was a member of the Committee on Relations With Colleges in 1940; in 1943–1944 he served as chairman of the Anthracite-Lehigh Valley Section, ASME; and in 1946–1947, served as chairman, ASME Region III, Student Branch Committee.

Harry Leland Solberg

Harry L. Solberg, head, school of mechanical engineering, Purdue University, was born in Brookings, S. Dak., March 30, 1898. He received the degrees of BS, S. Dak. State College, 1920; BSME, 1921, and MSME, 1923, from Purdue. Professor Solberg has been head of the mechanical-engineering department, Purdue University since 1941. His work has been outstanding. In association with Dean Potter and Professor Hawkins he has contributed much in the study of the properties of steam at high pressures, especially the viscosity of superheated steam at high pressures. He is co-author of "Elementary Heat Power" and has written many papers on research in various phases of high-pressure high-temperature steam.

Summer Academic Honors List

JOHN A. C. WARNER, Mem. ASME and since 1930 secretary - general manager, Society of Automotive Engineers, Inc., New York, N. Y., was honored by Worcester (Mass.) Polytechnic Institute at the commencement exercises when the honorary degree of doctor of engineering was conferred upon him. Under his leadership, SAE has tripled its membership, won the first Distinguished Service Award from U. S. Army Ordnance Department in World War II, and broadened its engineering services.

Others who received academic honors in 1950 are: James D. Cunningham, president ASME, who received the doctor-of-engineering degree from Rensselaer Polytechnic Institute; C. E. Davies, secretary ASME, doctor-of-engineering degree from Drexel Institute of Technology; Ralph E. Flanders, Hon. Mem. and past president, ASME, U. S. Senator from Vermont; and James R. Killian, president, M.I.T., doctor-of-laws degree from Harvard University; Hewett A. Gehres, Mem. ASME,

DR. JOHN A. C. WARNER, MEM. ASME, AND SECRETARY-GENERAL MANAGER, SAE, WHO WAS HONORED RECENTLY BY WORCESTER POLYTECHNIC INSTITUTE

doctor-of-science degree from Grove City (Pa.) College; Fred D. Knight, Mem. ASME, doctor-of-engineering degree from University of Maine; C. E. Kenneth Mees, vice-president, Eastman Kodak Company, doctor-of-science degree from Alfred (N. Y.) University; Henry B. Oatley, Fellow ASME, doctor-of-engineering degree from University of Vermont; Gwilym A. Price, Assoc. ASME, doctor-of-engineering degree from Stevens Institute of Technology; Charles O. Gunther, Mem. ASME, doctor-of-science degree from Stevens Institute of Technology; Percy L. Spencer, vice-president, Raytheon Manufacturing Company, doctor-of-science degree from University of Massachusetts at Amherst; and Harold Vagtborg, president, Southwest Research Institute, doctor-of-laws degree from Missouri Valley College, Marshall, Mo.

B. J. LAZAN, Mem. ASME, professor, Syracuse University, was awarded the Charles B. Dudley Medal by the American Society for Testing Materials in recognition of his outstanding technical paper presented at its previous annual meeting. Two other awards for papers were also made. Professors D. S. Clark, Mem. ASME, and D. S. Wood, Jun. ASME, California Institute of Technology, received the Richard L. Templin Award, and O. B. Ellis, senior research engineer, Armco Steel Corporation, received the Sam Tour Award.

* * *

ROBERT E. DOHERTY, Fellow ASME, third president of the Carnegie Institute of Technology, retired July 1, 1950. Dr. Doherty, who headed Carnegie Tech 14 years, was succeeded by Dr. J. C. Warner, former vice-president of the Institute.

* * *

JOHN RAY DUNNING, professor of physics, scientific director of Columbia's new cyclotron at Irvington-on-Hudson, N. Y., and a pioneer in atomic research, has been appointed dean of the school of engineering at Columbia University according to an announcement made by Pres. Dwight D. Eisenhower.

* * *

HANS P. DAHLSTRAND, Fellow ASME, and FRANK G. HOBART, Fellow ASME, were among the seven distinguished engineers honored at the second annual Wisconsin Engineers' Day dinner held at the University of Wisconsin Memorial Union on June 3, 1950.

* * *

FRED B. SEELY, Mem. ASME, professor, college of engineering, University of Illinois, received the Lammé Medal for distinguished contributions to the advancement of engineering teaching June 22, at the national convention of the American Society for Engineering Education.

* * *

ROLF ELIASSEN, professor, director of studies in sanitary engineering department of civil and sanitary engineering, M.I.T., received the $1000 ASEE George Westinghouse Award in recognition of outstanding teaching in engineering.

* * *

HARRY P. HAMMOND, Mem. ASME, dean, school of engineering, Pennsylvania State College, was the recipient of the first $500 ASEE James H. McGraw, Sr., Award for distinguished contributions to technical-institute education.

C. L. Lawrance, Inventor, Dies

CHARLES LANIER LAWRANCE, inventor of the air-cooled Wright Whirlwind airplane engine and a pioneer aviation engineer, died of a heart ailment on June 23, 1950, at the age of 67. In 1948 Mr. Lawrance resigned from The American Society of Mechanical Engineers because of failing health, after having been a member for twenty years.

American commercial and military aviation which was built upon the air-cooled engine, owes a heavy debt to Mr. Lawrance. His original three-cylinder 60-hp engine has grown into air-cooled giants of up to 4000 rated hp. The Spirit of St. Louis, on its epochal flight to Paris in 1927, was powered by a Lawrance engine. Byrd, Chamberlin, Hawks, Amelia Earhart, Kingsford-Smith, and a host of others owe their happy landings to the Whirlwind engine Mr. Lawrance designed after World War I.

It was his engines that furnished the power for pioneer flights across the Atlantic, the Pacific, and the North and South Poles. American military aviation in the last war was almost entirely powered by the lineal descendants of the Lawrance engine.

Mr. Lawrance was born in Lenox, Mass. After attending Groton School, he was graduated from Yale University in 1905. He studied architecture for three years at École des Beaux Arts in Paris before turning seriously to aviation. He was the recipient of many awards and several honorary degrees were conferred upon him.

ASME NEWS

Program for ASME 1950 Fall Meeting

Headquarters: Hotel Sheraton, Worcester, Mass.

THE technical program of the 1950 Fall Meeting of The American Society of Mechanical Engineers to be held at the Hotel Sheraton, Worcester, Mass., Sept. 19–21, 1950, reflects the vitality of the traditional industries of New England.

The three-day program, consisting of 23 technical sessions at which more than 50 papers will be presented and discussed, will also include the 1950 Calvin Rice Lecture, a program of three luncheons and a banquet, plant-inspection trips to industries in the Worcester vicinity, and an interesting program for the women.

The Calvin Rice Lecture will be delivered by Luigi Broglio, professor of aeronautical structures at the Graduate College of Rome, who was recently appointed visiting professor at Purdue University, Lafayette, Ind. The subject of his lecture will be "The Method of Equivalence Applied to Engineering and to Mathematical Physics." The Rice Lecture is named in honor of Calvin W. Rice who served as ASME secretary from 1906 to 1934, and whose work in the field of international relations did a great deal to increase understanding between the engineers of various countries.

The National Junior Committee is sponsoring the third of its conferences on "How Is Your P.D.?" (Professional Development). The Old Guard Committee is again supporting the conference by sponsoring the attendance of one junior member from each Section in Region I to the Junior Conference.

Ladies' Program

An interesting program has been arranged for the wives and guests of members attending the meeting. On Tuesday afternoon the women will tour the city of Worcester and visit the Higgins Armory where they will see a fine collection of medieval armor. In the evening there will be a theater party. The following day there will be a visit to the Old Sturbridge Village, a restoration of an early-nineteenth-century New England village. On Thursday there will be a visit to the Worcester Art Museum and in the afternoon a trip to the General Motors Company, Framingham, Mass.

Luncheons and Banquet

At each of the luncheons and the banquet a prominent speaker has been invited to address the Society on some topic of broad general interest. Members who do not choose to attend the luncheons may yet enjoy listening to the addresses. Arrangements will be made to have an ample number of extra chairs at each of the luncheons and the banquet so that after the meal has been served, members may come in and enjoy the remainder of the program in comfort.

The Tentative Program

In the tentative program which follows, preprint numbers are published to indicate those papers which have been preprinted and are available for sale. Members are urged to check the tentative program for any papers of interest to them. Three quarters of the Fall Meeting papers will be in preprint form at the time of the meeting and copies will be available at the meeting or can be obtained from New York. The tentative program follows:

TUESDAY, SEPTEMBER 19

8:00 a.m.

Registration

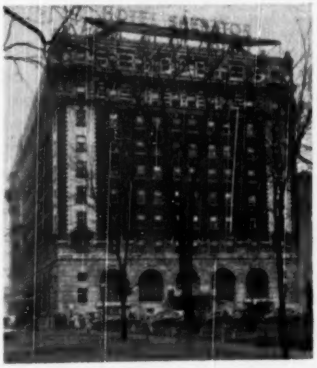
9:30 a.m.

Heat Transfer

Report of Progress on Measurements of Friction Coefficients, Recovery Factors, and Heat-Transfer Coefficients for Supersonic Flow of Air in a Pipe, by *Joseph Kaye*, associate professor of mechanical engineering, *Joseph H. Keenan*, professor of mechanical engineering, and *William H. McAdams*, professor of chemical engineering, Massachusetts Institute of Technology, Cambridge, Mass. (Paper No. 50—F-13)

Pressure Drop and Heat Transfer for Subsonic Air Flow in a Smooth Pipe, by *Warner Goldsmith*, assistant professor, and *R. A. Seban*, University of California, Berkeley, Calif.

Heat Transfer Through Gases at Low Pressures, by *R. E. Peck*, associate professor of chemical engineering, Illinois Institute of Technology, Chicago, Ill.; *Walter Fagan*, associate chemical engineer, naval reactor division, Argonne National Laboratory, Chicago, Ill.; and *P. P. Werlein*, graduate assistant in chemical engineering, Illinois Institute of Technology, Chicago, Ill. (Paper No. 50—F-16)



HOTEL SHERATON, WORCESTER, MASS., HEADQUARTERS FOR THE ASME FALL MEETING, SEPT. 19–21, 1950

Management (I)

Management and Its Critical Opportunity, by *Arthur B. Green*, consulting engineer, Needham, Mass. (Paper No. 50—F-1)

The Engineer's Stake in Public Relations, by *John D. Waugh, Jr.*, Pendray & Leibert, New York, N. Y. (Paper No. 50—F-3)

Rubber and Plastics (I)

Dynamic Shear Properties of Rubberlike Polymers, by *I. L. Hopkins*, Bell Telephone Laboratories, Inc., New York, N. Y.

Comparative Strengths of Some Adhesive-Adherend Systems, by *Nicholas J. De Lollis*, chemist, organic plastics section; *Nancy Rucker*, and *J. E. Wier*, National Bureau of Standards, Washington, D. C. (Paper No. 50—F-15)

Rubber-Phenolic Molding Material, by *Wyman Goss*, General Electric Company, Pittsfield, Mass.

Power (I)

Ultrasonic Flaw Detection in Pipes by Means of Shear Waves, by *C. D. Moriarty*, General Electric Company, Schenectady, N. Y. (Paper No. 50—F-14)

Bolted Joints for Piping Materials Having Widely Different Coefficients of Expansion, by *Edward G. Schmidt*, development engineering supervisor, engineering and research division; *E. P. DeCraene; I. H. Carlson; William S. Black*, research engineer, engineering and research division; *J. P. Magos*, Crane Company, Chicago, Ill.

12:15 p.m.

President's Luncheon

2:00 p.m.

Inspection Trips

Worcester Pressed Steel, including John Higgins Armory.
Norton Company, Abrasive and Machine Division.
Heald Machine Company.

2:30 p.m.

Management (II)—Education (I)

The Dynamics of Education and Training, by *Warren L. Ganong*, training adviser, H. P. Hood & Sons, Boston, Mass. (Paper No. 50—F-7)

Increasing the Competitive Position of Your Company Through Better-Trained Personnel, by *Donald P. Lane*, Lever Brothers, New York, N. Y. (Paper No. 50—F-2)

Rubber and Plastics (II)—Textile (I)

Plastics in the Textile Industry, by *F. P. Hunsicker*, Westinghouse Electric Corporation, Boston, Mass.

Industrial Applications for Nylon Plastics, by *J. E. Teagarden*, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del.

Power (II)—IIRD

Trend of Power-Plant Practice in Germany, by *Ludwig Musil*, professor, Technischen Hochschule, Graz, Opernring, Austria.

Trends in Modern Boiler Control, by *John F. Luhrs*, Bailey Meter Company.

5:00 p.m.

Calvin W. Rice Lecture

Luigi Broglio, professor, University of Rome, Rome, Italy; visiting professor Purdue University, Lafayette, Ind.
Subject: **The Method of Equivalence Applied to Engineering and to Mathematical Physics.**

8:00 p.m.

Junior Conference—Education (II)

Subject: **How Is Your P.D.? (Professional Development).**
Speaker: *William T. Alexander*, dean of engineering, Northeastern University, Boston, Mass.

WEDNESDAY, SEPTEMBER 20

9:00 a.m.

Inspection Trips

General Electric Company Plant.
Crompton Knowles Machine Company.

9:30 a.m.

Machine Design (I)—Safety (I)

A Main Spring Dynamometer, by *J. E. Hendricks*, supervisor of Watch Research Laboratory, Hamilton Watch Company, Lancaster, Pa.

The Design of Nonliner Leaf Springs, by *Stanley P. Clurman*, project engineer, Sperry Gyroscope Company, Great Neck, N. Y. (Paper No. 50—F-5)

Textile (II)

ASME Analyzes Textile-Mill Modernization, by *L. A. Runton*, manager, engineering department, M. T. Stevens Company, N. Andover, Mass.; *N. M. Mitchell*, president, Barnes Textile Associates, Inc., Boston, Mass.; *C. C. Bell*, director of research, Universal Winding Company, Providence, R. I.

Basic Distribution of Cost Dollar in Textile Manufacturing, by *Thomas D. Yutzy*, partner, Dudley, Anderson and Yutzy, New York, N. Y., in co-operation with Barnes Textile Associates, Inc.

Gas Turbine Power

Combined Steam and Gas-Turbine Processes, by *W. M. Rohsenow*, assistant professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.; and *G. H. Bradley, Jr.*, American Viscose Corporation, Lewiston, Pa.

Convenient Gas Properties and Charts for Gas-Turbine Calculations, by *Chapman J. Walker*, assistant division engineer, gas turbine division, General Electric Company, Schenectady, N. Y.

Fuels—Power (III)

Problems of Conversion From Coal Firing to Oil Firing, by *David H. Little*, engineer, Boston Edison Company, Boston, Mass.

The Use of Tungsten Carbide in Coal Pulverizers, by *Wayne C. Rogers*, design engineer, Riley Stoker Corporation, Worcester, Mass.

Standardized Boiler Units, by *Carl E. Miller*, assistant manager Industrial Division, Combustion Engineering-Superheater, Inc., New York, N. Y.

12:15 p.m.

Hydraulic Luncheon

(*Worcester Polytechnic Institute*)

2:00 p.m.

Inspection Trips

Bay State Abrasive Products Co.
Telechron Company

2:30 p.m.

Machine Design (II)

On the Design of Rotor-Coil Support Rings, by *James J. Ryan*, professor of mechanical engineering, University of Minnesota Minneapolis, Minn. (Paper No. 50—F-6)

Styling the Machine Tool, by *Harold Sizer*, assistant to director of design, and *Frank Burgess*, Brown & Sharpe Manufacturing Company, Providence, R. I. (Paper No. 50—F-4)

Hydraulic

Low-Velocity Studies of Salt-Velocity Method, by *L. J. Hooper*, professor of hydraulic engineering, and *L. C. Neale*, instructor, Worcester Polytechnic Institute, Worcester, Mass.

Textile (III)

Site Selection and Construction of Modern Worsted and Woolen Mills for Economical Low-Cost Operation, by *George Wrigley, Jr.*, engineer, J. E. Sirrine Company, Greenville, S. C.

Power (IV)

Steam Lift in Hot-Process Water Softeners, by *A. A. Kalinske*, director of development, Infilco, Inc., Chicago, Ill.

Investigation of Steam Separation in Boiler Drums Through Studies on a Model, by *Erich A. Farber*

Materials Handling (I)—Management (III)

Material Handling and Related Volume Production Problems at Electrolux, by *Arthur F. Murray*, works manager, Electrolux Company, Old Greenwich, Conn.

How to Package and Use Materials Handling Economically, by *E. H. Ashley*, packaging and materials-handling engineer, General Electric Company, Schenectady, N. Y.

Metal-Cutting Data and Bibliography and Cutting Fluids—I Production Engineering (I)

A Method of Measuring the Metallic Wheel-Loading Characteristics of Grinding Fluids, by *Samuel Manilych*, development engineer, Naval Shipyard, Brooklyn, N. Y.; *L. H. Sudholz*, chemical engineer; and *G. S. Mapes*, chemist, Socony Vacuum Laboratories. (Paper No. 50—F-9)

Residual Grinding Stresses in Mild Steel, by *J. Frisch* and *E. G. Thomsen*, University of California, Berkeley, Calif. (Paper No. 50—F-10)

7:00 p.m.

Banquet

THURSDAY, SEPTEMBER 21

9:00 a.m.

Inspection Trips

Wyman Gordon
Reed Prentiss Corporation

9:30 a.m.

**Safety (II)—Management (IV)—
Materials Handling (II)**

Building Safety into Textile Machinery, by *Edward R. Schwarz*, professor, Massachusetts Institute of Technology, Cambridge, Mass. (Paper No. 50—F-12)

Dust Hazard Relative to Grinding Operations, by *K. T. Benedict*, doctor, medical director, Norton Company, Worcester, Mass. (Paper No. 50—F-8)

The Declining Accident Rate Due to Substituting Machines for Men in Material-Handling Operations, by *F. J. Shepard*, president, Lewis-Shepard Products, Inc., Watertown, Mass.

Wood Industries

Furniture Design From the Standpoint of Lumber Utilization, by *Frank T. Parrish*, Heywood-Wakefield Company, Gardner, Mass.

Development in Wall-Board Construction from Wood Waste, by *Robert Caughey*, Souhegan Mills, Wilton, N. H.

Woodworking Cutters, by *Harry Pavitt*, Simonds Saw and Steel Company, Fitchburg, Mass.

Textile (IV)

Production Crimping of Natural Fibers, by *J. H. Pfau*, assistant chief, Mechanical Research Section, and *W. D. Hay*, mechanical research engineer, Alexander Smith and Sons Carpet Company, Yonkers, N. Y.

Construction of Modern Cotton and Rayon Mills, by *John R. Potter*, engineer, Lockwood Greene Engineers, Inc., New York, N. Y.

Production Engineering (II)—Metal-Cutting Data and Bibliography and Cutting Fluids (II)

Design of Lanchester Damper for Elimination of Metal-Cutting Chatter, by *Robert S. Hahn*, research engineer, Heald Machine Company, Worcester, Mass. (Paper No. 50—F-11)

A Report on the Development and Status of Thread Rolling, by *A. Bradford Reed*, president, Reed Rolled Thread Die Company, Worcester, Mass.

12:15 p.m.

Wood Industries Luncheon

Presiding: *Charles R. Nichols, Jr.*, Joseph Dixon Crucible Company, Jersey City, N. J.
Speaker: *Nathan Tufts*, president, New England Box Company, Greenfield, Mass.
Subject: **New England Wood-Waste Problems and Utilization**

2:00 p.m.

Inspection Trips

General Motors Corporation
Heywood-Wakefield Company, Gardner, Mass.

2:30 p.m.

Materials Handling (III)

Materials-Handling Research, by *R. F. Weber*, general supervisor materials-handling research, International Harvester Company, Chicago, Ill.

New Developments in Materials Handling at the Norton Company, by *Allan F. Hardy, Jr.*, plant engineer, Norton Company, Worcester, Mass.

Production Engineering (III)

Considerations in Designing Tools for Powder Metallurgy, by *Irving J. Donahue*, powder metallurgy consultant, Shrewsbury, Mass.

Metals Engineering

Steel and Aluminum Closed Die Forging Techniques, by *O. Frank Burbank*, chief product engineer; and *Arnold L. Rustay*, chief metallurgist, Wyman-Gordon Company, Worcester, Mass.

Comparative Density of Cast and Wrought Metal, by *E. O. Dixon*, chief metallurgist and mechanical engineer, and *E. J. Foley*, supervisor of physical metallurgy, The Ladish Company, Cudahy, Wis.

Tentative Program for ASME-IIRD Conference Sept. 18–22

THE Instruments and Regulators Division of The American Society of Mechanical Engineers is co-operating with the Instrument Society of America in the fifth Annual Instruments Conference and Exhibit to be held at the Municipal Auditorium, Buffalo, N. Y., Sept. 18–22, 1950.

The IIR Division is sponsoring a technical program composed of four technical sessions at which 12 papers will be presented on such subjects as blast-furnace instrumentation, radiation pyrometry in the steel industry, measurements as a career or avocation, compressibility effects in hydraulic servomechanisms, and others. Features of the program will be a luncheon at which C. C. Furnas, director, Cornell Aeronautical Laboratory, will speak on the subject "Research in Industry," and a panel discussion on education in instrument engineering at which two papers will be presented as a basis of the discussions.

Of special interest to mechanical engineers will be an instrument exhibit staged under the auspices of the Instrument Society of America at which the latest developments in the field of instrumentation will be demonstrated. The exhibit will run for the entire week.

The tentative program follows:

MONDAY, SEPTEMBER 18

10:00 a.m.

Session No. 1

Instrumentation of Open-Hearth Furnace, by *C. E. Mortensen*, Bethlehem Steel Company, Lackawanna, N. Y.

Co-ordinated System of Control of Open-Hearth Furnaces, by *J. R. Green*, Brown Instrument Company, Philadelphia, Pa.

Blast-Furnace Instrumentation, by *E. T. Mortson* and *S. J. Paisley*, National Tube Company, McKeesport, Pa.

Instrumentation of Top Pressure Blast Furnaces, by *F. H. Janecek*, Republic Steel Corporation, Cleveland, Ohio

2:30 p.m.

Session No. 2

Instrumentation of the Blast Furnace, by *J. E. Stukel*, Youngstown Sheet and Tube Company, Youngstown, Ohio.

The Instrumentation of Billet Reheating Furnaces, by *C. J. Petry*, American Steel and Wire Company, Worcester, Mass.

Radiation Pyrometry in the Steel Industry, by *Donald Robertson*, Leeds and Northrup Company, Philadelphia, Pa.

A Direct Recording Technique for Pressure Cycles in High-Pressure Reciprocating Equipment, by *R. A. Strub*, E. I. du Pont de Nemours and Company, Charleston, W. Va.

TUESDAY, SEPTEMBER 19

10:00 a.m.

Session No. 3

Panel Discussion on Education in Instrument Engineering, by *Carl F. Kayan*, head, department of mechanical engineering, Columbia University, New York, N. Y.

Measurements as a Career or Avocation, by *V. F. Hanson,* E. I. du Pont de Nemours and Company, supervisor, applied physics section, engineering department, Wilmington, Del.

Automatic Control Courses—Their Unifying Influence in Engineering Education, by *John A. Hrones,* professor, mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass.

12:30 p.m.

Luncheon

Presiding: *George C. Crewson,* Buffalo Electro Chemical Company, Inc., Buffalo, N. Y.

Speaker: *C. C. Furnas,* director, Cornell Aeronautical Laboratory.

Subject: **Research in Industry.**

2:30 p.m.

Session No. 4

Instrument Contacts, by *Earle I. Shobert 2nd,* Stackpole Carbon Company, St. Marys, Pa.

An Alternating Current Vector Motor, by *Otto Jensen* and *Charles R. Crewson,* ITE Circuit Breaker Company, Philadelphia, Pa.

Compressibility Effects in Hydraulic Servomechanisms, by *Robert Senters Wick,* mechanical engineering deparment, University of Illinois, Urbana, Ill.

by *L. J. Dawson,* field engineer, Ingersoll-Rand Company, New York, N. Y.

1:45 p.m.

Sampling Pipe-Line Streams

A Portable Automatic Sampler, by *W. E. Roads,* engineer, Service Pipe Line Company, Tulsa, Okla.

Discussion of Pipe-Line Sampling, by *F. A. Warren,* Ohio Oil Company, and *L. S. Wrightsman,* Humble Oil Company.

WEDNESDAY, SEPTEMBER 27

9:00 a.m.

Offshore Operations

Modern Practices in Offshore Drilling, by *A. F. T. Seale,* chief engineer, Kerr-McGee Oil Industries, Oklahoma City, Okla.

Operation of Submarine Pipe Line and Production Facilities in the Gulf of Mexico, by *G. W. Osborne,* The California Company, New Orleans, La.

1:45 p.m.

Pipe-Line Surge Problems

Instruments for Pipe-Line Pressure-Surge Studies, by *F. O. Stivers,* engineer, Humble Pipe Line Company, Houston, Texas.

Discussion of Surge Problems, led by *S. Logan Kerr,* S. Logan Kerr and Company, Philadelphia, Pa.

Petroleum Industry Authorities Contribute to ASME Petroleum Mechanical Engineering Conference

THE 1950 Petroleum Mechanical Engineering Conference to be held at the Hotel Roosevelt, New Orleans, La., Sept., 25–28, 1950, and sponsored annually by the Petroleum Division of The American Society of Mechanical Engineers, will bring together men of authority in the fields of petroleum production, transportation and refining from 28 companies, one research institution, and one university. A total of 36 technical papers, all contributing to the theme "Cost Reduction," will be presented and discussed at the four-day Conference.

The technical program has been arranged under three headings, production, transportation, and refining. Five technical sessions will be held under each of the headings and each series will run concurrently. This means that there will be three simultaneous technical sessions during the morning and afternoon periods. Accordingly, in the tentative program which follows, technical sessions are grouped chronologically under each of the three headings for convenient reference.

A registration fee will be charged for attendance at the Conference. The fee will be $2 for ASME members and $3 for nonmembers. All registrants will receive a package of all available reprints of papers presented at the Conference.

Luncheons

A welcome luncheon will be held on Monday, Sept. 25, H. J. Voorhies, general manager, Baton Rouge Refinery, Standard Oil Company, Louisana Division, will be the main speaker. His topic will be "The Significance of a Cost-Reduction Program in Petroleum Refining Operations."

"Petroleum in Peace and War" will be the subject of a banquet address to be delivered by Bruce K. Brown, president, Pan-American Southern Corporation, New Orleans, La.

The Conference will conclude with an all-day field trip on Thursday, Sept. 28, to the Freeport Sulphur Company at Port Sulphur, La. The trip will consist of a 10-mile boat trip, an inspection of sulphur-production facilities, a luncheon, following which the party will return to the hotel late in the afternoon. Members planning to make the trip should register early so proper facilities can be provided for them.

REFINING PROGRAM

MONDAY, SEPTEMBER 25

2:00 p.m.

Refinery Materials

Corrosion in Amine Plants, by *C. L. Blohm,* assistant manager, and *F. C. Riesenfeld,* research chemist, Research and Development, The Fluor Corporation, Ltd., Los Angeles, Calif.

Metals for Phosphoric Acid, by *M. A. Scheil,* director, metallurgical research, A. O. Smith Corporation, Milwaukee, Wis.

Corrosion of Alloys at High Temperatures with Especial Reference to Attack by V_2O_5, by *E. M. Skinner,* The International Nickel Company, New York, N. Y.

TUESDAY, SEPTEMBER 26

9:00 a.m.

Refinery Power and Design

Steam and Power Plant Economy and Capability at Louisiana Station, by *R. J. Robertson,* superintendent of production, and *W. B. Guerney,* assistant superintendent of production, Gulf States Utilities Company, Lake Charles, La.

Effect of Time on Physical Properties of Tanks, by *T. L. White,* chief engineer, Commercial Shearing and Stamping Company, Youngstown, Ohio

1:45 p.m.

Refinery Maintenance and Construction

Lubrication Problems in Refineries, by *F. V. Leverett,* chief power engineer, Texas Company, Port Arthur, Texas.

Refinery Lubrication—A Management Problem, by *L. F. Jahncke,* Socony Vacuum Oil Company, Inc., New York, N. Y.

Welding Quality Control in a Petroleum Refinery, by *A. F. Blumer,* head, special inspection section, Esso Standard Oil Company, Louisiana Division, Baton Rouge, La.

WEDNESDAY, SEPTEMBER 27

9:00 a.m.

Valves

Some Aspects of the Selection of Valves for Refinery and Pipe-Line Services, by *F. M. Van Deventer,* assistant chief engineer, Walworth Company, Inc., New York, N. Y.

The Problems in the Design of a Dry Plug Valve for Industry, by *J. Y. Snyder,* president, Wedgeplug Valve Company, Inc., New Orleans, La.

Oil-Industry Gaskets, by *H. H. Dunkle,* assistant manager, packing department, Johns Manville, Company, New York, N. Y.

1:45 p.m.

Synthetic Plant Design, Operation, and Costs

Gas Synthetic Demonstration Plant Design and Construction, by *R. G. Dressler,* chief, Gas Synthesis Plant, Bureau of Mines, Louisiana, Mo.

The Coal Hydrogenation Plant Operations, by *C. C. Chaffee,* chief, operating section, and *E. A. Clarke,* chief, planning section, Bureau of Mines, Louisiana, Mo.

Cost Estimates of Synthetic Fuels Derived From Coal, by *L. C. Skinner,* chief, engineering section, Bureau of Mines, Louisiana, Mo.

TRANSPORTATION PROGRAM

MONDAY, SEPTEMBER 25

2:00 p.m.

Pumping-Station Problems

Pipe-Line Engine and Compressor Lubrication and Maintenance, by *O. H. Moore,* assistant general superintendent, Tennessee Gas and Transmission Company, Houston, Texas.

Crank-Case Explosions, by *F. V. Cook,* master mechanic, Service Pipe Line Company, Tulsa, Okla.

TUESDAY, SEPTEMBER 26

9:00 a.m.

Pumping-Station Problems

A Review of the Factors to Be Considered in the Selection and Maintenance of Diesel Lubricating Oils, by *E. B. Rawlins,* engineer, fuels and lubricants, Cooper Bessemer Corporation, Mount Vernon, Ohio.

Design and Development of Mechanical Seals,

PRODUCTION PROGRAM

MONDAY, SEPTEMBER 25

2:00 p.m.

Casing Design and Percussion Drilling

Design of High-Strength Casing Strings, by *B. E. Curran,* chief engineer, Kerotest Manufacturing Company, Pittsburgh, Pa.

Allowable Loads on an Unsupported Casing Column, by *J. A. Reed, 2nd,* associate petroleum engineer, and *H. H. Meredith Jr.,* supervising petroleum engineer, Humble Oil and Refining Company, Houston, Texas.

The Bassinger Rotary Percussion Drill, by *Robinson Brown,* supervisor, engineering design, Southwest Research Institute, San Antonio, Texas.

TUESDAY, SEPTEMBER 26

9:00 a.m.

Oceanography

Gulf Coast Hurricane Design Data, by *A. H. Glenn,* director, A. H. Glenn and Associates, New Orleans, La.

Engineering Aspects of Oceanography as Related to Offshore Operations, by *Dale F. Leipper,* acting head, department of oceanography, A.&M. College of Texas, College Station, Texas.

1:45 p.m.

Production Materials

Study of 9 Per Cent Nickel Tubing in Corrosive Condensate Wells, by *L. W. Vollmer,* director, and *C. N. Bowers,* section head, M&P Chemistry Division, Gulf Research and Development Company, Pittsburgh, Pa.

Protection of Structures Exposed to Sea Water, by *B. B. Morton,* corrosion engineer, Development and Research Division, International Nickel Company, New York, N. Y.

Properties and Applications of Ductile Cast Iron, by *M. Kuniansky,* vice-president, Lynchburgh Foundry Company, Lynchburgh, Va.

WEDNESDAY, SEPTEMBER 27

9:00 a.m.

Gas-Well Problems

Well Performance in Relation to Gas-Transmission-Line Requirements, by *E. R. Phillips,* production engineer, Transcontinental Gas Pipe Line Corporation, Houston, Texas.

Gas Propulsion as Applied Today to Oil Production, by *D. G. Knox,* gas-lift engineer, National Supply Company, Torrance, Calif.

Design of Hydraulic Pumping Equipment, by *P. J. Donnelly,* manager, pump department, W. C. Norris Company, Tulsa, Okla.

1:45 p.m.

Production Research

The Effect of Patents on Petroleum Production and Development, by *Paul F. Hawley,* patent supervisor, Stanolind Oil and Gas Company, Tulsa, Okla.

Fatigue Testing and Development of Drill Pipe-to-Tool-Joint Connections, by *W. S. Bachman,* engineer, Research Engineering Department, Hughes Tool Company, Houston, Texas.

Lubricated Plug Valves for Drilling and Well-Head Service, by *E. E. Hedene,* chief engineer, Merco Nordstrom Valve Division, Rockwell Manufacturing Company, Pittsburgh, Pa.

25 Per Cent Dues Increase Proposed at ASME 1950 Semi-Annual Meeting

R. P. Kroon Receives Spirit of St. Louis Medal

THE 1950 Semi-Annual Meeting of The American Society of Mechanical Engineers held at the Hotel Statler, St. Louis, Mo., June 19-23, 1950, was a memorable experience for more than 700 members and guests who took part in a well-balanced program of technical sessions, social events, and plant-inspection trips.

By members of the St. Louis Section the meeting will be remembered for the honors conferred on three of their members and for the presentation of two awards symbolizing the community spirit of St. Louis. By 13 junior members representing each of the Sections in Region VI who attended the meeting as guests of the Old Guard, the meeting will be remembered for the Junior Conference where they rubbed shoulders with Council and other Society leaders in an atmosphere of good fellowship and where they caught the excitement that comes from contact with stimulating personalities and new ideas.

But by most members the St. Louis meeting will be remembered for the action of the Regional Delegates Conference and the Semi-Annual Business Meeting which recommended an increase of memberhip dues by approximately 25 per cent.

Since a dues increase cannot be made without a change in the ASME constitution, the action means that the matter of dues will be submitted to a vote of the membership by a special ballot which will be mailed in September.

PRESIDENT AND MRS. JAMES D. CUNNINGHAM

Technical Sessions

The technical program consisted of 29 sessions at which 53 papers on a variety of mechanical-engineering subjects were presented and discussed. Forty-three of the papers are available in pamphlet form and may be purchased from the ASME Order Department, 29 West 39th Street, New York, N. Y. Members are urged when ordering to give the title, author, and number of each paper. Price is 25 cents per copy to ASME members; 50 cents to nonmembers. Those papers which will not be published in full in MECHANICAL ENGINEERING will appear in abstract form in the ASME Technical Digest section. In this issue 15 of these digests are published. Others will be published in subsequent issues.

A feature of the technical program was the sessions sponsored by the ASME Aviation Division in co-operation with the Institute of the Aeronautical Sciences and the American Helicopter Society. These described an exploratory helicopter stability program at Cornell Aeronautical Laboratory, and reported on a study conducted in the Langley Helicopter Tower on basic performance and control characteristics of aerodynamic servocontrolled rotor systems.

For power men, papers on the present status of fly-ash precipitation and the art of mechanical dust collection were of major interest. The Railroad Division discussed treating feedwater for railway Diesel steam generators and the dynamics of "shimmy" in passenger-car trucks. The Applied Mechanics Division sponsored three sessions which heard discussion of a method of designing a resonant quartz-crystal tranducer for research in ultrasonics, the solution of elastic plate problems by electrical analogies, and others. Papers on the chemical removal of copper from boilers and phosphoric acid cleaning of boilers, prepared under the auspices of the Joint Research Committee on Boiler Feed Water Studies and the Power Division, attracted many members.

The President's Luncheon

The President's Luncheon on Monday was the first of the general events which brought members, their wives, and guests together. C. B. Briscoe, director of public utilities, St. Louis, Mo., was toastmaster. He welcomed members to St. Louis and reviewed the special events on the program planned to make the meeting a memorable one. He suggested that members visit the site of the projected Jefferson Memorial which someday would commemorate adequately the greatness of Jefferson's Louisiana Purchase.

Forrest Nagler, vice-president, ASME Region VI, introduced James D. Cunningham, president ASME, who spoke on "The Engineer's Civic Responsibility."

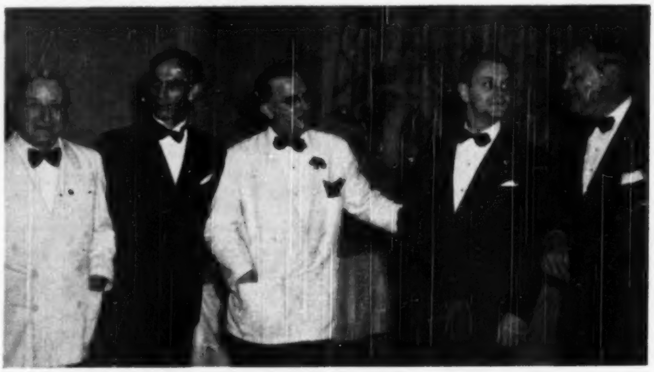
The essence of democracy, according to President Cunningham, is individual participation in the processes of government. The engineers who by training have a deep respect for fundamentals and whose day-to-day habits engender logical thinking and a study of consequences, should, he urged, individually take upon themselves the task of exposing spurious arguments and the inevitable consequences of reckless spending and stifling taxation.

Analyzing political motivations, President Cunningham stated that there were two forces active today. There was the urge to personal freedoms—freedom of thought, action, the right to control one's destiny—which, he said, was an internal force. There was also the urge to security—freedom from loss of creature comforts, which he characterized as an external force.

The dangerous trends in government today were not the results of malice nor were they premeditated ends of unscrupulous schemers. They were the results, many of them unforeseen, of decisions taken in the face of real social and economic problems—decisions made in good faith by persons who had not studied or who had minimized the consequences, President Cunningham stated.

Engineers as a group tend to be introspective. They prize the personal freedoms which have made America great. But if the external security-seeking forces in political thought were to be curbed, he warned, "all your resources as engineers and all your wisdom as human beings" must be called into play whenever unanalytically minded persons unquestioningly accept unsound social or economic ideas.

President Cunningham deprecated the



W. E. BRYAN, F. V. HARTMAN, CHAIRMAN, ST. LOUIS SECTION, R. R. TUCKER, H. I. ANSOFF, AND SPENCER T. OLIN LINE UP BEFORE THE BANQUET BEGINS

"slick" public-relations programs which often substitute "showmanship" for action. People were impressed by what they read, he stated, only when this relates to actions confirmed by personal experience.

1951 Nominations Announced

At the banquet on Wednesday, the Society honored three distinguished St. Louisans and conferred two awards symbolizing the progress and stability of St. Louis—the Spirit of St. Louis Medal and the Spirit of St. Louis Junior Award. R. R. Tucker, professor of mechanical engineering, Washington University, St. Louis, Mo., was chairman.

Prior to the presentation of awards, C. E. Davies, secretary ASME, explained the process by which the Society elects its officers and announced the nominations for 1951. They are: for President, J. Calvin Brown, consulting engineer and attorney at law, Los Angeles, Calif.; for Vice-Presidents, Harry Reginald Kessler, manager, Republic Flow Meters Company, New York, N. Y., Region II; Stephen Dewey Moxley, vice-president, American Cast Iron Pipe Company, Birmingham, Ala., Region IV; John Theodore Rettaliata, dean of engineering, Illinois Institute of Technology, Chicago, Ill., Region VI; Carl J. Eckhardt, professor, mechanical engineering, The University of Texas, Austin, Texas, Region VIII; for Directors at Large, Lionel J. Cucullu, assistant to chief engineer, New Orleans Public Service, Inc.. New Orleans, La., and Harold Edward Martin, district manager, Babcock and Wilcox Company, New York, N. Y.

A certificate was presented to F. W. Olin, president, Western Cartridge Company, East Alton, Ill., honoring his 55 years as a member and Fellow of the Society. Mr. Davies recalled that Mr. Olin contributed $25,000 to the Society in the difficult days of the depression. Mr. Olin's certificate was accepted by his son, Spencer T. Olin, Mem. ASME, vice-president, Olin Industries, Inc., East Alton, Ill. A second certificate, accepted by F. V. Hartman, chairman, St. Louis Section, was presented to Edward Flad, consulting engineer and a member of the Society since 1891. Commenting on the high sense of civic responsibility among St. Louis engineers, Mr. Davies noted that Mr. Flad had been a member of a survey committee which formulated the city charter and that the toastmaster, Mr. Tucker, was currently serving in a similar capacity.

Mr. Davies also announced that the Council had recently elected Harry Miller Pflager to honorary membership and that arrangements were being made to confer this honor on Mr. Pflager in a ceremony during the Annual Meeting in New York late in the fall.

H. I. Ansoff Wins Junior Award

The Spirit of St. Louis was a real and dramatic thing which was sensed by all visitors, Mr. Davies said. The Society was fortunate in having that spirit symbolized by two of its awards—the Spirit of St. Louis Medal established by an endowment fund created by citizens of St. Louis in 1929, and by the Spirit of St. Louis Junior Award which honors authors, under 30 years of age, of outstanding papers on an aeronautical subject published by the Society. President Cunningham then presented the Junior Award to Harry Igor Ansoff, Rand Corporation, Santa Monica, Calif., for his paper "Stability of Linear Oscillating Systems With Constant-Time Lag." Dr. Ansoff was born of American parents in Vladivostok. He is a graduate of Stevens Institute of Technology where he was formerly faculty instructor in physics. During the war he did liaison work with naval officers of the USSR and taught physics at the U. S. Naval Academy. He is currently employed as an associate mathematician.

SPIRIT OF ST. LOUIS AWARD WINNERS

(H. I. Ansoff, Spirit of St. Louis Junior Award, *left*, and R. P. Kroon, Spirit of St. Louis Medal.)

The Spirit of St. Louis Medal was presented to Reinout Pieter Kroon, Mem. ASME, manager of engineering, aviation-gas-turbine division, Westinghouse Electric Corporation, Philadelphia, Pa. The citation read, "For his leadership in the development of the first American design of a turbojet power plant for aviation service making possible increased plane speeds, high altitude limits; more efficient airplane design; and for his technical leadership in many fields which have contributed to the advance of American aviation.

Dr. Kroon was born in Holland in 1907. He graduated from Zurich Graduate Technische Hochschule in 1921, and came to the United States in 1931. He became a citizen in 1938. As chairman of the Aviation Division in 1947, and currently as chairman of the Applied Mechanics Division, he has been active in the ASME and other technical societies for many years.

The "Gimmie" Spirit

Edwin G. Nourse, former chairman of the President's Council of Economic Advisers, speaking on "An Engineering Approach to Stabilized Economy," declared that the gimmie spirit was rampart among the American people and the demand for personal security is being put above the old spirit of personal creative achievement. He warned that the economic stability of this country was endangered by a selfish struggle for monopolistic strength among larger interest groups at a time when America stood at a crucial stage in its history.

Labor, capital, management, agriculture, and government have not recognized the underlying solidarity of interests among all parts of the economy, he stated, and each group has pursued its own immediate advantage without regard to the wide repercussions on the national economy.

He was impressed, he said, by the high sense of professionalism among engineers. He asked the engineering profession to work with the statisticians and the social scientists for a scientific approach to economic stability. The economy could be compared to a machine designed in accordance with latest knowledge which must be modified continually as new knowledge is uncovered. An engineering project could not run with the kind of sabotage inflicted by special-interest groups who seek a "national killing" out of temporary advantage, Dr. Nourse warned.

Nation Is Stockpiling Know-How

Because we must face the implications of the actions of other nations, peace is the most important piece of business in the world today, Col. James L. Walsh declared at the joint ASME-American Ordnance Association luncheon on Thursday.

Speaking on the subject "Working for Peace," Colonel Walsh reviewed the history of ordnance production in this country. Unrolling a 30-ft scroll with the aid of two assistants, he illustrated the precipitous and tardy acceleration of ordnance production in World Wars I and II. On the reverse side of the scroll was another chart showing that, while the enemy in World War II outnumbered U. S. forces on every front, American fatalities were 20 per cent those of the enemy. Machine power, he declared, meant lives. The experience of the last few years has convinced this nation that strength is the key to peace. Mechanized power and the knowledge among potential enemies of our readiness, ability, and willingness to take retaliatory action is good peace insurance.

America is currently stockpiling know-how rather than materials. This policy has already achieved some astonishing savings. Colonel Walsh estimated stockpiling of know-how can achieve the same degree of preparedness as materials stockpiling at $^1/_3$ of 1 per cent of the cost.

Congress can appropriate billions of dollars at a moment's notice, Colonel Walsh warned, but it can't appropriate a second of time. By anticipating needs, stockpiling know-how, the nation is, in effect, appropriating precious time.

Education in Economics Needed

At the Management Luncheon on Tuesday,

AT THE SEMI-ANNUAL MEETING BANQUET IN ST. LOUIS, MO.

(*Left to right:* Spencer T. Olin, Edwin G. Nourse, and James L. Walsh.)

Edward W. Jochim, manager, Personal Products Corporation, Chicago, Ill., warned that industry must embark on a program of plant-wide education in "basic economics" from top levels of management to all its employees if it is to solve present-day labor-management problems successfully. Ignorance and disagreement about fundamental economics, he said, prevent labor and management from speaking the same language.

If each plant in the country did a reasonably good job in basic economic education of its management and employees, such problems as sky-high taxes that destroy incentive and cause waste in government at local, state, and national levels would be corrected by the citizens at the polls.

Mr. Jochim told the engineers that the three problems pressing management most are: Employees block the attainment of the full advantages of technological improvement; employees do not give a fair day's work, and employees are demanding and obtaining increased direct wages and "fringes" not justified by increased productivity.

He suggested conferences held on the employees' own time without compensation as the best means of instruction.

"Human nature tends to little regard that for which little is paid and to treasure that for which much is paid," he said. "We are all familiar with the tendency of employees to attend almost anything 'on company time' and the difficulties of holding their effective attention once they do attend."

Joint Aviation Luncheon

Until more experience is accumulated by the helicopter industry, Government offices charged with certification of helicopter performance can aid industry by making requirements conservatively difficult, Frank N. Piasecki, president, Piasecki Helicopter Corporation, Morton, Pa., told more than 50 members and guests at a luncheon sponsored jointly by the ASME Aviation Division, Institute of the Aeronautical Sciences, and the American Helicopter Society.

Mr. Piasecki spoke on "What's Wrong With Today's Helicopters?" He covered ten categories of criticism of today's rotary-wing aircraft.

Much remains to be done, he said, to improve the relatively limited pay load which in the largest helicopter is less than 10 per cent that of the largest airplane.

"Helicopters of the size of the DC-4 are under construction. There does not appear to be any question as to their feasibility. One project plans a rotor diameter sufficient to lift a light tank."

While the maximum speed of 140 mph of the latest helicopter seems snaillike, its function is not to travel great distances and therefore high speeds are not a necessary performance requirement.

Costs of helicopters, Mr. Piasecki stated, averaged $30 to $40 per lb of useful load in comparison with $15 to $25 for the transport type of aircraft. Volume production, standardization of materials, processes, and accessories can materially reduce costs of helicopters. "Maximum peacetime helicopter-production plans have been in units of 100 and are usually for less."

PRINCIPALS AT THE AVIATION LUNCHEON
(*Left to right:* Frank N. Piasecki, Herman Hollerith, and C. R. Wood, Jr.)

Inspection Trips Popular

A feature of the Semi-Annual Meeting was a series of plant-inspection trips to some of the leading industrial plants in St. Louis. On Tuesday morning a group visited the Midwest Piping and Supply Company, Inc., where they saw forming, welding, machining, and heat-treating operations on a wide range of pipe fittings, while another group visited the Wagner Electric Corporation, manufacturers of small motors and automotive electrical and hydraulic brake equipment.

On Tuesday afternoon a party left for East Alton, Ill., to inspect the Western Brass Mill Division of the Western Cartridge Company to see one of the largest brass mills under one roof. On Wednesday morning a large group visited the Venice Power Plant of the Union Electric System which has a 240,000 kw capacity. The following day a party visited the plant of the Anheuser-Busch, Inc., and the Busch-Sulzer Bros., Division of Nordberg Manufacturing Company. On Thursday afternoon another group watched the manufacture of carrier-based jet fighter planes, helicopters, and guided missiles at the McDonnell Aircraft Corporation.

On Friday, after the technical sessions were over, a party of more than 30 members and guests boarded a bus for a visit to the Synthetic Liquid Fuel Plant of the U. S. Bureau of Mines at Louisiana, Mo., some 90 miles north of St. Louis. Equipment designed for operation at 10,000 psi and 1000 F was inspected. A one-ton-per-hour oxygen plant was in operation and much new equipment was in the process of erection. This plant, with a schedule of 200 to 300 barrels of gasoline per day, utilizes liquid-phase hydrogenation to liquefy the coal and vapor-phase hydrogenation to convert the liquefied coal to gasoline and by-products.

Women Enjoy River Trip

Running concurrently with the technical program was an interesting program for women which was enjoyed by wives and guests of members. On Monday there was a sightseeing tour of St. Louis which included Shaw's Garden, Forest Park, Washington University, and residential sections. On Tuesday morning a visit was arranged to The Inn at St. Albans, on the Missouri River. On Wednesday there was a boat trip on the Mississippi River on the river boat *Admiral*. Thursday was a full day with a visit to the historic Campbell House.

Committees

THE following committees of the St. Louis Section were responsible for the success of the meeting: *General*, J. C. Parmely, chairman, R. W. Merkle, vice-chairman, J. J. Sieber, secretary, R. O. Slattery, treasurer; *Technical Events*, G. V. Williamson, chairman, C. E. Harsay, vice-chairman; *Inspection Trips*, L. W. Morrell, chairman, W. R. Atchison, vice-chairman, A. C. Ballauer, L. J. Gorday, J. F. McLaughlin, Jr., J. W. Morrison, L. H. Niebling, R. W. Seifert; *Registration*, W. J. Woodruff, chairman, G. M. Setzekorn, vice-chairman; *Entertainment*, A. J. Leussler, chairman, J. R. Buss, vice-chairman, J. T. McFarland, J. M. Lyle, S. S. Sample; *Hotel*, C. B. Briscoe, chairman, R. E. Wright, vice-chairman, J. A. Albert, A. L. Bennett, P. R. Finck; *Printing and Signs*, C. H. Rulfs, chairman, J. O. Steinman, vice-chairman; *Publicity*, R. M. Boyles, chairman, H. E. Frech, Jr., vice-chairman, Gilbert Gottscalk; *Reception*, R. R. Tucker, chairman, Albert Vigne, vice-chairman, C. J. Kippenhan; *Finance*, David Larkin, chairman, J. H. Bascom, E. A. Kerbey, vice-chairman; *Transportation*, A. L. Heintze, chairman, G. R. Hughins; *Woman's Committee*, Mrs. J. K. Bryan, chairman, Mrs. C. B. Briscoe, vice-chairman.

A HIGH LIGHT OF THE WOMEN'S PROGRAM WAS A BOAT TRIP ON THE MISSISSIPPI RIVER ON THE RIVER BOAT *Admiral*

J. Calvin Brown

Nominated for President

ASME OFFICERS *Nominated for* 1950–1951

DURING the Meeting of The American Society of Mechanical Engineers in St. Louis, Mo., June 19–23, 1950, J. Calvin Brown, mechanical engineer and attorney at law, Los Angeles, Calif., was nominated by the National Nominating Committee for the office of President of the Society for the year 1950–1951.

Regional Vice-Presidents named by the Committee to serve two-year terms on the Council of the ASME were Harry Reginald Kessler, New York, N. Y.; Stephen Dewey Moxley, Birmingham, Ala.; John Theodore Rettaliata, Chicago, Ill.; and Carl J. Eckhardt, Austin, Texas.

Directors at Large named by the Committee to serve a four-year term on the Council were Lionel J. Cucullu, New Orleans, La., and Harold Edward Martin, New York, N. Y.

Members of the Committee making the nominations were: Zenas R. Bliss, Providence, R. I., representing Region I; V. Weaver Smith, New York, N. Y., representing Region II; Henry R. Snelling, Washington, D. C., representing Region III; Claude L. Huey, Atlanta, Ga., representing Region IV; John W. Brennan, Detroit, Mich., representing Region V; William H. Oldacre, Chicago, Ill., representing Region VI; J. Alan Campbell, San Francisco, Calif., representing Region VII; Henry B. Atherton, Kansas City, Mo., representing Region VIII.

Election of ASME officers for 1950–1951 will be held by letter ballot of the entire membership, closing September 28, 1950.

Biographical sketches of the nominees follow on the succeeding pages.

Nominated for President

J. Calvin Brown

J. CALVIN BROWN, who has been nominated to serve for one year as President of The American Society of Mechanical Engineers, attended public and high schools in Los Angeles, and the California Institute of Technology. Member Pi Tau Sigma.

He studied law at Hamilton College of Law where he received the degrees of L.L.B. and L.L.M. He also attended special courses at Southwestern University and the University of Southern California.

Mr. Brown is an attorney at law and mechanical engineer, specializing in patent, trademark, and copyright litigation before the United States Courts. He is a member of the bars of the U. S. Supreme Court and of the highest courts, both State and Federal, in California, Illinois, and the District of Columbia.

He became a member of the Society in 1928 and was chairman of the Entertainment Committee at the ASME Semi-Annual Meeting in Los Angeles, Calif., in 1938. He was chairman of the Southern California Section from 1941 to 1943; chairman of the Nominating Committee, Southern California Section in 1944 and 1945, general chairman of the ASME Semi-Annual Meeting in Los Angeles in 1943, a Manager of the Society in 1943 and 1944, and Vice-President from 1945–1949. He was general chairman of the War Production Board Meeting in Los Angeles in 1943.

Mr. Brown is past-president of the Los Angeles Engineering Council of Founder Societies; past-chairman, Los Angeles Bar Association, Patent Section; past-president, Los Angeles Patent Law Association, and a member of the various sections of the American Patent Law Association, The American Bar Association, and California State Bar Association; vice-president of the International Adventurers, an active member of the Society of Motion Picture Engineers, Society for the Advancement of Science, member, Water and Power Resources Committee (Calif.), and of various social clubs in and around Los Angeles, including Town Hall. He was chairman of Engineers, 7th War Loan Drive, and an appeal agent of the Selective Service System.

Nominated for Regional Vice-Presidents

To Serve Two-Year Term

HARRY R. KESSLER

STEPHEN D. MOXLEY

Harry R. Kessler

HARRY R. KESSLER, who has been nominated from Region II to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in New York, N. Y., on September 13, 1898.

He graduated from Stevens Institute of Technology with a degree in mechanical engineering in 1921. After graduation he was employed in the operating department of the United Electric Light and Power Company (now the Consolidated Edison Company of New York) at the Sherman Creek and Hell Gate Power Stations. Several years later he joined the staff of Smoot Engineering Corporation, specializing in the field of automatic combustion control. After several years in the service department of the company, he became Chief Engineer of the Contract Division. In 1934 he became associated with Republic Flow Meters Company of Chicago when this company acquired the Smoot Engineering Company. At present he is Manager of the Republic Flow Meters Company's New York office.

Mr. Kessler joined the Society in 1922 and is an active worker in the Metropolitan Section. In 1946 he served as treasurer of the Metropolitan Section and for the next two years he was chairman of the Section. Currently he is chairman of the Membership Committee of the Instruments and Regulators Division. He is also serving as vice-chairman of Mayor William O'Dwyer's Smoke Abatement Conference of the City of New York. He served in the Army during World War I.

Stephen D. Moxley

STEPHEN DEWEY MOXLEY, who has been nominated from Region IV to serve as Regional Vice-President of The American Society of Mechanical Engineers, was born on June 3, 1898 in Arnot, Pa. His engineering training began as an apprentice draftsman for the Tennessee Coal, Iron and Railroad Company. He was graduated from the University of Alabama in 1921, continued his education, and was awarded an M.S. degree of engineering in 1922. In 1932 he received the degree of mechanical engineer from his alma mater. After working at Cleveland, Ohio and Tuscaloosa, Alabama, he returned to the Tennessee Coal and Iron Railroad Company as draftsman. In 1923 he joined the American Cast Iron Pipe Company. Three years later, he was made chief engineer and in 1937, assistant to the vice-president in charge of engineering. Since 1946 he has been a vice-president of this company.

Mr. Moxley is the inventor of several pieces of equipment used in the manufacture of cast-iron pipe by the sandspun process. Among these are a cupola charger, flask handling device, metal-pouring device, magnetic clutch, and others. He is the author of "Dust Collection in Foundry," published by the American Foundry Association, "The Engineer in Industry," "Selection of Cupola Blowing Equipment," and others. Mr. Moxley became a member of the ASME in 1924 and has been active in ASME affairs since. He is a past-chairman of the Birmingham Section, a past-president of the Engineers Club of Birmingham, a member of the American Foundrymen's Association, Birmingham Kiwanis Club, Board of Stewards, First Methodist Church, and the Birmingham Planning Board. He is a member of Tau Beta Pi, Theta Tau, Alpha Phi Epsilon, Pi Tau Sigma, Birmingham Citizens Committee of 100, The Club, and Birmingham Down Town Club.

J. T. Rettaliata

J. T. RETTALIATA, who has been nominated from Region VI to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Baltimore, Md., Aug. 18, 1911.

He received his engineering education at The Johns Hopkins University Baltimore,Md., where he was graduated in 1932, and received his doctor's degree in mechanical engineering in 1936. Shortly after, he joined the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., and became manager of the research and gas-turbine development division of that company. In 1940 Dr. Rettaliata was granted a leave of absence by his employer to prepare a report on gas turbines for the National Academy of Sciences. In 1943 he went to England on a mission for the U. S. Navy Bureau of Aeronautics to investigate British jet-propulsion development. Two years later he was again in Europe, this time in Germany for the U. S. Bureau of Ships, to investigate

J. T. RETTALIATA

CARL JOHN ECKHARDT

enemy technical developments in hydrogen-peroxide submarines.

Dr. Rettaliata has been active on many administrative and technical committees of the ASME. In 1947–1948 he was chairman of the Gas Turbine Power Division and is currently a member of the General Technical Committee of the Gas Turbine Power Division. He is a member of the Power Test Code Committee and also of the Power Test Code Committee No. 22 on Gas Turbines. Dr. Rettaliata is also a member of the Subcommittee on Turbines of the National Advisory Committee for Aeronautics.

Currently dean of engineering at the Illinois Institute of Technology, Chicago, Ill., Dr. Rettaliata holds two patents on turbine blading and jet-propulsion apparatus and is consultant to Allis-Chalmers Manufacturing Company. He is a member of many technical societies and the recipient of several honors, among them the ASME Junior Award in 1941, and the Pi Tau Sigma Gold Medal Award in 1942. He is the author of a number of articles published in the trade press on steam and gas turbines. Since 1936 he has delivered some 125 talks on the gas turbine before engineering groups in the U. S.

Carl John Eckhardt

CARL JOHN ECKHARDT, who has been renominated from Region VIII to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Yorktown, Texas, Oct. 28, 1902. He was educated at Brackenridge High School, San Antonio, Texas, and at The University of Texas, Austin, Texas, from which he received the degree BSME in June, 1925.

In 1925–1926 he served the Westinghouse Electric and Manufacturing Company in its South Philadelphia plant as a graduate student. In 1926 he became a member of the teaching staff of The University of Texas as instructor of mechanical engineering and from that university he received his master's degree in mechanical engineering in 1930. From 1929 to 1936 he was adjunct professor of mechanical engineering at his alma mater, as well as superintendent of power plants for the university. From 1936 to the present time he has been professor of mechanical engineering and superintendent of utilities at the university. In the latter capacity Professor Eckhardt has designed, conducted the negotiations for, supervised the installation of, operated, and maintained the utilities of The University of Texas.

Since 1934 Professor Eckhardt has contributed articles to many technical magazines, among them, *Combustion*, *Southern Power Journal*, *Heating and Ventilating*, and *Southern Power and Industry*.

In 1929 he joined the ASME as a junior member and became a member in 1937. He was honorary chairman of the ASME student branch of The University of Texas in 1939, and chairman of the South Texas Section in 1946. He was a delegate to the Regional Delegates Conference in 1946, and Speaker of that Conference in 1947. Professor Eckhardt is also a member of Sigma Xi, Tau Beta Pi, and Pi Tau Sigma.

Nominated for Directors at Large

To Serve Four-Year Terms

LIONEL J. CUCULLU

HAROLD E. MARTIN

Lionel J. Cucullu

LIONEL J. CUCULLU has been nominated for the office of Director at Large of The American Society of Mechanical Engineers to serve a four-year term. He was born March 25, 1906, in New Orleans, La. He was graduated from Louisiana State University, Baton Rouge, La., in 1927, with a BS degree in sugar engineering. He served as a chemist in 1926 with the Godchaux Sugars, Inc., and, the following year was employed by the New Orleans Sewerage and Water Board on a number of testing and research jobs. The first three years after graduation were spent as an office engineer of the South Coast Company, manufacturers of sugar. In 1930 he joined the New Orleans Public Service, Inc., and has been with that company ever since. He has served in various capacities as sales engineer, director of power sales, power engineer, and currently is assistant to chief engineer for the central engineering department, which is responsible for electric generation, transmission, distribution and utilization engineering, gas distribution and utilization engineering, and roadway engineering for mass transportation systems.

Mr. Cucullu joined the Society as a junior member in 1936 and became a member in 1941. He has served the New Orleans Section as secretary-treasurer, vice-chairman, and chairman. In 1943 he was chairman of the National Agenda Committee and in 1947 secretary of the National Nominating Committee. He has been a member of Region VIII Committee on Sections since 1948 and was elected chairman last year. He is also a member of the National Medals Committee of the Board on Honors.

Mr. Cucullu is a member of the Alpha Chi Sigma, Tau Beta Pi, Louisiana Engineering Society of which he is currently president, and the Louisiana Council of Engineers of which he is also president. He is also a member of the following trade associations: New Orleans Chamber of Commerce, U. S. Chamber of Commerce, American Gas Association, National Association of Manufacturers, New Orleans Electrical Association, and the American Ordnance Association.

Harold E. Martin

HAROLD EDWARD MARTIN, who was nominated for the office of Director at Large of The American Society of Mechanical

Engineers to serve a four-year term, was born in New York, N. Y., on Nov. 26, 1900. He received his education at Trinity School in that city and at Columbia University and the Brooklyn Polytechnic Institute. He finished in 1921, having studied chemical engineering.

Mr. Martin's service in World War I was in the Tank Corps of the U. S. Army between the years 1917 and 1919. He began his professional career in 1919 with the General Chemical Company, as research chemical engineer; then in 1920 he took a position as engineer with Johns-Manville Corporation where he remained until 1929. His work with Johns-Manville included: application engineering and development work on mechanical packings and refractories for two and one-half years; three and one-half years in charge of furnace-insulation work, which included design, estimating, sales, erection, service work, and application engineering; manager of Eastern Division Insulation Department, covering the entire field of thermal insulation.

From 1929 to 1931 Mr. Martin held the position of district manager of the Cincinnati office of the Fuller Lehigh Company and in 1931, when the Fuller Lehigh Company was merged with The Babcock & Wilcox Company, he was transferred to the New York office as sales engineer. Since 1941 he has been district manager in New York for that company. In addition, he supervises the export activities of The Babcock & Wilcox Company.

From 1942-1945 Mr. Martin served as a member of the Metropolitan Section Executive Committee, and from 1946-1950 as a member of the Organization Committee. He is now chairman of the Organization Committee.

Besides his membership in ASME, Mr. Martin holds membership in the National Geographic Society, the American Legion, and Forty and Eight. His membership in clubs includes Sleepy Hollow Country Club, Bankers Club of America, Campfire Club of America, Uptown Club of New York, Century Club (Syracuse, N. Y.), and the Engineers' Club (New York, N. Y.), and several hunting and fishing clubs. He is a licensed professional engineer in New York.

ASME 1951 Nominating Committee Organizes

SELECTED at the 1950 Semi-Annual Business Meeting of The American Society of Mechanical Engineers, St. Louis, Missouri, June 19, 1950, the 1951 National Nominating Committee at its organization meeting chose Venton L. Doughtie, The University of Texas, University Station, Austin 12, Texas, as chairman, and Paul T. Onderdonk, Consolidated Edison Company of New York, Inc., 4 Irving Place, New York 3, N. Y., as secretary.

Plans were made for a preliminary meeting of the committee at the 1950 Annual Meeting, New York, N. Y., at which arrangements will be made as to time and location of the executive meeting for nomination of the Society Officers in 1951.

The 1951 National Nominating Committee is composed of the following:

REGION I. A. J. Ferretti, Northeastern University, 360 Huntington Ave., Boston 15, Mass. Charles H. Coogan, Jr. *1st Alternate*, mechanical engineering department, University of Connecticut, Storrs, Conn.; Harry E. Harris, *2nd Alternate*, 229 Thorme St., Bridgeport 6, Conn.; and David A. Fisher, *3rd Alternate*, mechanical engineering department, University of Connecticut, Storrs, Conn.

REGION II. Paul T. Onderdonk, secretary, Consolidated Edison Company of New York, Inc., 4 Irving Place, New York 3, N. Y.; Kenneth J. Moser, *1st Alternate*, Stevens Institute of Technology, Hudson St., Hoboken, N. J.; and W. H. Byrne, *2nd Alternate*, Byrne Associates, Inc., 140 Nassau Street, New York 7, N. Y.

REGION III. William G. McLean, department of mechanics, Lafayette College, Easton, Pa.; Charles C. Di Ilio, *1st Alternate*, mechanical engineering department, The Pennsylvania State College, State College, Pa.; and C. B. Campbell, *2nd Alternate*, Steam Division, Westinghouse Electric Corporation, Lester Branch P.O., Philadelphia 13, Pa.

REGION IV. J. A. Keene, Alabama Power Company, 600 N. 18th Street, Birmingham 2, Ala.; E. M. Williams, *1st Alternate*, Clinchfield Fuel Comapny, Box 410, Spartanburg, S. C.; and J. Marshall Johnson, *2nd Alternate*, Tennessee Valley Authority, Power Building, Chattanooga, Tenn.

REGION V. F. F. Borries, Westinghouse Electric Corporation, 207 W. 3rd St., Cincinnati, Ohio; C. R. Davis, *1st Alternate*, Davis Automatic Controls, Ltd., 5 Blackmore St., Toronto 5, Ont., Can.; and Henry S. Walker, *2nd Alternate*, Detroit Edison Company, 2000—2nd Ave., Detroit 26, Mich.

REGION VI. H. A. Bolz, general engineering department, Purdue University, Lafayette, Ind.; Robert T. Mees, *1st Alternate*, Research Department, Caterpillar Tractor Company, Peoria 8, Ill.; and Harold L. Heywood, *2nd Alternate*, Kearney & Trecker Corporation, 6781 W. National Ave., West Allis 14, Wis.

REGION VII. W. A. Pearl, mechanical engineering department, Washington State College, Pullman, Wash.; F. B. Lee, *1st Alternate*, Fairman B. Lee Company, 219 Central Building, Seattle 4, Wash.; and A. R. Weigel, *2nd Alternate*, Consolidated Western Steel Corporation, 5700 S. Eastern Ave., Los Angeles 54, Calif.

REGION VIII. Venton L. Doughtie, chairman, The University of Texas, University Station, Austin 12, Tex.; Arnold R. Mozisek, *1st Alternate*, Cowles and Company, 1203 Texas Bank Bldg., Dallas, Texas; and Robert P. Lockett, Jr., *2nd Alternate*, A. M. Lockett and Company, 308 Whitney Building, New Orleans, La.

Regional Delegates Favor Dues Increase

INCREASE of membership dues, retention of the present Fellow grade requirements, expansion of the Engineering Societies Personnel Employment Service, and many other recommendations were among the actions referred to the Council of The American Society of Mechanical Engineers by the ASME Regional Delegates Conference in St. Louis, Mo.

The conference, which meets annually during the Semi-Annual Meeting, is composed of two representatives from each of the Society's eight Regions appointed by the Regional Administrative Committee on which each ASME Section has representatives. The conference considers any aspect of Society operation proposed by the Sections.

Recommendations of the conference are presented to Council in joint session with the Regional Delegates and are referred to the appropriate boards and committees for appropriate action.

Dues

Following a resolution expressing disfavor of any policy of limiting the number of technical sessions at the Annual Meeting which would prevent presentation of pertinent and useful information in mechanical engineering, the delegates took up the question of increasing membership dues. Only two delegates were of the opinion that loss of membership would result from an increase of 25 per cent in dues.

It was the consensus that publication and some other useful service recently curtailed "could and should go ahead" if dues were increased. Many agenda items disapproved in the light of the Society's financial situation could be reopened.

Fellow Grade

A suggestion to modify the requirement for the Fellow grade so that the Council by unanimous vote, could make an exception to the requirement of 13 years in the member grade was not approved. Many eminent engineers otherwise qualified for the Fellow grade sometimes cannot meet the member grade requirement because much of their professional life was spent in branches of engineering other than mechanical engineering. In turning down the proposal, the delegates strengthen the concept of a Fellow as an engineer who is not only distinguished in the profession but also one who has served the ASME for a long time.

Employment Committees

Extension of the Engineering Societies Employment Services to Sections not now adequately served by one of the ESPS offices in Chicago, Detroit, New York, or San Francisco was approved. The delegates suggested that all Sections appoint committees on employment of three to five members to work with ESPS. Such committees could provide literature and information locally about ESPS and could work with local industry and members to make the Service more useful to both.

In another action, the delegates favored continued encouragement of young engineers to become registered as soon as possible. A proposal to withdraw the designation "engineer in training" and to substitute some other name for the young men who have passed their basic engineering-registration examinations was not approved.

Dues Increase Among Four Changes Proposed to ASME Constitution

Letter Ballot to be Mailed to Members in September

An INCREASE in dues of $5 for all grades of membership in The American Society of Mechanical Engineers except the junior member grade for the man who is less than 30 years of age or one less than 7 years out of college was recommended by Ralph A. Sherman, Director at Large ASME, before the Semi-Annual Business Meeting in St. Louis, Mo. The full text of Mr. Sherman's statement appears on page 688.

The recommendation, which had won the support of the Regional Delegates, was read as the report of a special committee composed of Mr. Sherman and Vice-Presidents Forrest Nagler and A. C. Pasini. The committee had been appointed by the Executive Committee of Council on May 18, 1950, to study what could be done to end a threatened curtailment of Society services to members.

The committee's recommendation was a proposal to amend the Constitution which can be done only by a letter-ballot vote of the entire membership. The ballot will be mailed in September.

William H. Byrne, chairman, 1950 Regional Delegates Conference, after reviewing the conclusions of the Regional Delegates on the matter of dues, moved that "the proposed amendment—increasing the Society dues ..... presented by Mr. Sherman, be mailed in printed form to the members of the Society for action ..... as provided for in Article C-16 Section 1 of the Constitution." The motion was passed.

Society Growth Increasing Costs

In the face of higher operating costs arising out of growth of membership and a cost of living index which was 35 per cent higher in 1949 than in 1924 when the last increase in dues was made, the Society was able to keep going only because of the economy of serving large numbers and the indirect dues increase involved in the concept of the publication plan introduced in 1948, Mr. Sherman said.

Because of the bleak financial horizon, the Executive Committee of Council and the Finance Committee, at a joint meeting on May 18, 1950, gave serious consideration to a reduction in text pages of Mechanical Engineering by six per month and a reduction in the number of national meetings and technical sessions at each meeting.

The committee felt, Mr. Sherman reported, that the Society should not only maintain quality of service to members but should even expand them. This could be done in no other way than "to increase dues." The five-dollar increase would mean about $95,000 added to the Society's annual income or about 10 per cent of the Society's income from dues and other activities.

Consensus of Regional Delegates

Mr. Byrne reported that the Regional Delegates had given consideration to the matter of Society dues. He reported (1) that practically all delegates believed it was necessary to increase dues; (2) that only two delegates believed it would bring a loss of membership if dues were increased 25 per cent; (3) that initiation fees could possibly be reduced to encourage new members if dues were increased; (4) that most delegates believed any loss in membership would be minor and temporary; (5) that publications and other items of interest to members which had been curtailed, could and should go ahead if dues were increased; and (6) that a number of agenda items disapproved by the Regional Delegates in consideration of the Society's financial problems, would probably be reconsidered if dues were increased.

It was in view of these considerations that he moved acceptance of Mr. Sherman's proposal Mr. Byrne said.

Other Proposed Amendments

Three constitutional amendments were proposed by Lester Smith, chairman of the Constitution and By-Laws Committee. All three were approved and will be submitted to a letter-ballot vote of the entire membership.

The first, which had to do with Article B-7, Paragraph 8 and Article C-6, Section 2, seeks to correct a conflict between these two parts of the constitution. Mr. Smith proposed that Article B-7, Paragraph 8, be deleted and that Article C-6, Section 2, be changed to read "the Council shall consist of 22 members of the Society *who have reached the grade of Member* comprising the President, last five surviving Past-Presidents, the Vice-President from each regional group, and the remainder of the Council group shall be the Directors at Large" (the proposed change in wording appears in italics).

H. H. Snelling of Snelling and Hendricks, Washington, D. C. in discussing these amendments, urged members to vote against them because, he said, the alleged conflict did not exist and because the changes would deprive junior members of the right of becoming members of Council.

WILLIAM H. BYRNE MAKING THE MOTION AT THE SEMI-ANNUAL BUSINESS MEETING TO INCREASE MEMBERSHIP DUES BY APPROXIMATELY 25 PER CENT

The second amendment had to do with Article C-6, Section 5, and was introduced to assist the new Council when it takes office in December. The constitution now reads that the Council must meet at the close of the Annual Meeting. The proposed amendment would change this to read "the Council shall meet promptly after the business meeting. . . ." Since the business meeting is usually held early, during the Annual Meeting, this change would not make it necessary for Council members to remain at the Meeting an extra day.

The third proposal pertained to Article C-8, Section 2, and proposes that the phrase "after the Annual Meeting of the Society" be deleted to make this Section conform with the second of Mr. Smith's amendments.

Proposed Dues Schedule

Grade of membership	Present dues	Proposed dues	Change
Fellow	$20	$25	$5
Member	20	25	5
Associate	20	25	5
Junior Member (Over 33 or more than 10 years out of school)	20	25	5
Junior Member (30-33, or 7 to 10 years out of school)	15	20	5
Junior Member (under 30 or less than 7 years out of school)	10	10	none

Ralph A. Sherman's Statement on Dues Increase

Present Dues Schedule Means Further Reduction in Services

THE FOLLOWING statement was made by Ralph A. Sherman, Director at Large ASME, at the Semi-Annual Business Meeting in St. Louis, Mo., June 19, 1950. In it Mr. Sherman reviews the Society's financial position and proposes an increase in membership dues of $5 for all grades of membership except the junior member grade for men who are under 30 years of age or veterans less than seven years out of college:

At the meeting of the Executive Committee of Council with the Finance Committee on May 18, the budget for the coming fiscal year was reviewed. In this review, it became quite clear that unless the income of the Society was increased, the services of the Society to its members would have to be decreased. As a result of the discussion of the problem, the President appointed a committee consisting of Vice-Presidents Forrest Nagler, Al Pasini, and me to consider the problem and to report to Council at the Semi-Annual Meeting. My purpose now is to brief the report that we presented to Council.

We found that the dues of members of the Society are basically the same today as established in 1924, 26 years ago. When we consider that the cost-of-living index in 1949 was 35 per cent higher in 1949 than in 1924, one is led to ask how the Society has been able to keep going on the same dues from its members.

Three things have made this possible. First, a greatly increased membership; the cost of services has increased at a rate less than that of the increase in number of members. Second, the income from advertising has increased rapidly. Third, the Society has, in effect, increased the members' dues because it has decreased the services to members; two examples of the decrease in service are the fact that a member must pay an added amount if he wishes the Transactions and that he must pay for preprints.

What are the prospects for the future? The membership is still increasing, but it appears that we may have reached the point where the cost of serving more members will increase more than proportionately to the increase in membership.

Because the income from advertising has been so helpful, we looked into the possibility of further increase from that source. We find that MECHANICAL ENGINEERING is now getting just about as much high-class advertising as is possible.

To decrease expenses, a reduction of MECHANICAL ENGINEERING text pages by six per month ,has been proposed. Further, there has been a discussion of a reduction of the number of papers and number of meetings.

Both of these steps constitute a reduction in the service to members whereas all of us on Council and, we believe, all members feel that services should be maintained and, if possible, expanded. Our Committee found no other way to increase income than to increase the dues of the members. This, we believe, should be approved by the members, for what other article or service do we buy that costs the same in 1950 that it cost in 1924?

We have presented a recommendation to Council, which approved it for presentation at this meeting, for submission to letter ballot of the membership in the form of a change in Article C-5, Section 2, of the Constitution. Essentially, this would provide for an increase of the dues of all classes of members by five dollars per year except for those of the junior grade who now pay ten dollars; this rate would not be increased.

A provision, not concerned with the dues increase, is made for the older veterans who are now graduating. This would give them a period of seven years after graduation in which their dues would remain at ten dollars and an additional three years at the new higher figure of twenty dollars instead of the present requirement of an increase at ages 30 and 33. This period in which to become established in engineering seems to be owing to the older graduates.

What could this increase in dues mean to the Society? Based on the membership as of May 31, the increased dues income would be about $95,000 per year. This is an average per member of all grades of about $4.50. Distributed to publications and to meetings, this amount, although only about ten per cent of the total income from all sources, could materially and visibly increase the services which the members receive.

We trust, also, that the Finance Committee and Council would be wise enough to budget at least a modest amount of this increase to be laid aside as surplus. Substantially nothing has been added to our surplus for the past three years, but we should be building up a reserve for the leaner days that may come in the future.

Actions of the ASME Council

At a Meeting in St. Louis, Mo., June 18–19

THE Council of The American Society of Mechanical Engineers met on June 18–19, 1950, during the Semi-Annual Meeting in St. Louis, Mo. Those present at one or more of the three sessions were: James D. Cunningham, president; E. W. O'Brien, J. M. Todd, D. Robert Yarnall, past-presidents; C. J. Eckhardt, F. M. Gunby, A. R. Mumford, Forrest Nagler, A. C. Pasini, J. C. Reed, Arthur Roberts, Jr., vice-presidents; J. B. Armitage, B. P. Graves, J. A. Keeth, A. L. Penniman, Jr., T. E. Purcell, W. M. Sheehan, and R. A. Sherman, directors at large; E. J. Kates, assistant treasurer; C. E. Davies, secretary; H. B. Atherton, J. W. Brennan, and H. H. Snelling, Nominating Committee; E. N. Davidson, L. A. Evers, and A. J. Snider III, junior observers; S. D. Moxley, E. E. Williams, J. Calvin Brown, and S. R. Beitler, guests; W. E. Hogan, A. C. Crownfield, W. H. Byrne, P. T. Onderdonk, W. G. McLean, S. B. Sexton, M. E. Turner, B. E. Sherrill, E. W. Jacobson, Thompson Chandler, F. V. Hartman, L. S. Whitson, L. B. Cooper, S. G. Eskin, J. H. Keyes, and W. M. Richtmann, Regional Delegates; Ernest Hartford, executive assistant secretary, and A. F. Bochenek, editorial staff.

Dues Increase

The report of the Special Committee on Increase of Dues recommending a dues increase of approximately 25 per cent was accepted and R. A. Sherman was requested to prepare a proposal for action at the Semi-Annual Business Meeting.

Board on Honors

Upon recommendation of the Board on Honors, the following were elected Honorary Members of the ASME: Harold V. Coes, Upper Montclair, N. J., Lillian M. Gilbreth, Montclair, N. J., Frederick Ljungström, Stockholm, Sweden, and Harry M. Pflager, St. Louis, Mo.

Applied Mechanics Reviews

Transfer of the editorial office of *Applied Mechanics Reviews* from Illinois Institute of Technology, Chicago, Ill., to the Midwest Institute, Kansas City, Mo., was approved. The transfer will be made by September 1, 1950.

1951 Annual Meeting

Atlantic City, N. J., as the city for the 1951 Annual Meeting was approved.

Dues to Foreign Members

Following a review of policy on dues of members in foreign countries who may be subjected to financial hardship because of the exchange situation, it was voted to continue the present policy adopted in 1945.

Reciprocal Privileges

In accordance with a recommendation of the Conference of Engineering Societies of Western Europe and the United States, the secretary was authorized to make bilateral agreements with societies participating in the Conference and those participating in the British Commonwealth Conference for reciprocal exchange of membership privileges. The Council also approved the other recommendations of the Western Conference.

World Engineering Conference

Upon recommendations of the Board on Public Affairs, withdrawal of the ASME from the World Engineering Conference was authorized.

Constitution and By-Laws

Three constitutional amendments were dis-

cussed and referred to the Semi-Annual Business Meeting for action (for a discussion of these see page 687).

Three amendments to the By-Laws dealing with qualifications for admission, boards and committees, and election of officers and directors received first reading.

Three other amendments to the By-Laws having to do with fees and dues and election of officers and directors, having had two readings, were adopted.

Standardization Committee

Following a study of the functions of the Standardization Committee by the Organization Committee and the Board on Codes and Standards, it was voted not to dissolve the Committee and to make its members a part of the Board on Codes and Standards, but to maintain the Committee as now described in the By-Laws.

Sections

Upon recommendation of Vice-President Roberts, the Memphis Section was disbanded and its members assigned to the Chattanooga Section. A change in the name of the Akron-Canton Section to the Akron Section was approved.

Policy on Student Branches

Following a discussion of the policy on establishment of student branches, the Council agreed to modify the last sentence of paragraph 3 of the policy statement to read as follows: "Exceptions to this rule may be made in the case of institutions offering curricula in general and other fields of engineering, which have been approved by ECPD, provided such an institution does not have an unaccredited curriculum in mechanical engineering."

Certificates of Award

Certificates of Award were approved for the following retiring chairmen of Sections: Alfred J. Ferretti, Boston; C. B. Campbell, Philadelphia; J. S. Earhart, Southern California; and E. W. Allardt, Canton-Alliance-Massillon Subsection.

Unity of the Engineering Profession

The Council expressed its appreciation and support of E. J. Kate's activities as ASME representative to the Unity Conference (see page 671) and ASME representative on the EJC subgroup on Unity of the Engineering Profession.

Regional Delegates

The Council received with thanks the report of the Regional Delegates Conference and expressed their appreciation for the work of which the report was evidence.

Purdue University Host to ASME 1950 Applied Mechanics Conference

APPROXIMATELY 200 engineers attended the 1950 national conference of the Applied Mechanics Division of The American Society of Mechanical Engineers which was held on the Purdue University campus, Lafayette, Ind., June 22–24. Professional engineers and university professors from all sections of the country were represented. Purdue University was host to the ASME Applied Mechanics Division for the first time in nearly 20 years.

Twenty-three technical papers were presented during the three-day conference, covering recent developments in dynamics, plasticity, vibrations, and elasticity. All of the technical papers were enthusiastically received, with an average attendance of 125 to 150 at each of the technical sessions.

A high light of the conference was the annual banquet, at which the principal speaker was A. A. Potter, dean of the Schools of Engineering at Purdue, and a past-president and honorary member ASME. R. P. Kroon, chairman of the Applied Mechanics Division, presided. The dinner was held in the Cary Hall banquet room on the Purdue campus.

Speaking on the topic, "The Engineering Teacher," Dean Potter said, "Our colleges and universities must not fail to appreciate the place the teacher occupies in developing people who are good, as well as scientifically competent, and who have a full appreciation of the importance of good government and a true appreciation of human values."

Decay of German Learning

Dean Potter pointed out that the decay of German learning during the reign of Nazism may be traced to the fact that universities in Germany were considered research centers and that teaching was incidental, "thus depriving the German youth of a type of education which encourages sensibility to human relationships.

"The purpose of education is to civilize and humanize our young people so they will fit into their environment and will be making contributions as useful citizens," he said. "We are interested in having the engineer not only useful and competent in his field, but also a good citizen with a broad perspective, an open mind, and with a critical and constructive approach to life; an individual who thinks clearly, acts courageously, and feels nobly toward others. Good engineering education should strive to develop the ability to do and to create as well as to think, to communicate; it should train to make valid judgments and to evaluate ethical as well as practical situations."

In discussing the characteristics of a good teacher, Dean Potter said, "All good teachers are necessarily scholars and researchers, and are constantly trying to excel in their field through the acquisition of new knowledge. It must be recognized that teaching is not only a science, but also an art. Every teacher has his own art. With some, it is mastery of the subject, with others it is a gift for clarity of expression or the power of persuasion. In all cases, however, humanity is a distinguishing characteristic of the great teacher, who understands and loves his students as he understands and loves the subject he teaches. He must have the ability to inspire and instill in his students sound character, worthy ambitions, an insight into right living, an understanding of the meaning of liberty, and an appreciation of human sanctity."

Teachers as ASME Presidents

Dean Potter pointed out that ASME has had 68 presidents since its founding in 1880, and that of these, 13 were engineering teachers, a very large number considering the small percentage of teachers in the membership of the Society.

Another high light of the Purdue meeting

AT THE BANQUET OF THE APPLIED MECHANICS DIVISION AT PURDUE UNIVERSITY, LAFAYETTE, IND.

(*Left to right at the speaker's table:* Martin Goland, Nathan Newmark, Rolland G. Sturm, Lloyd H. Donnell, C. E. Davies, A. A. Potter, R. P. Kroon, John M. Lessells, R. E. Peterson, and Ralph Wiley.)

was a lawn party held in the Cary Hall Court on the evening of the first day. This enabled the wives as well as the members in attendance to become better acquainted. A tea was held also for the ladies. Another feature of general interest was the inspection trips to the Ross Gear and Tool Company and to the Lafayette plant of the Aluminum Company of America.

R. G. Sturm, of the engineering mechanics department at Purdue, was chairman of the conference steering committee, which included R. C. Binder, D. E. Bloodgood, H. A. Bolz, W. A. Knapp, R. W. Kettler, H. L. Solberg, and M. J. Zucrow, all of Purdue. The Central Indiana Section, headed by H. A. Bolz of Purdue, co-operated in the meeting as did the Applied Mechanics Committee of ASCE. Chairmen of the various conference committees included M. M. McClure, registration; E. S. Ault, hospitality; E. W. Azpell, housing; J. L. Waling, displays and exhibits; C. W. Beese, inspection trips; W. B. Sanders, special meals; Harry Rubenkoenig, transportation; A. R. Spalding, student aids; and Mrs. H. L. Solberg, ladies' entertainment.

OGP Division Holds One of its "Most Successful" Conferences

"ONE of the most successful as well as the most enjoyable," is how one of the members characterized the 1950 Oil and Gas Power Conference and Exhibit sponsored by the Oil and Gas Power Division of The American Society of Mechanical Engineers at the Lord Baltimore Hotel, Baltimore, Md., June 12–16, 1950. Behind this enthusiastic approval was a near-record attendance, a sellout of exhibit space, and an excellent technical program which evoked spirited discussions at the technical sessions.

The opening event of the Conference was a welcome luncheon at which Col. L. G. Smith, chairman, ASME Baltimore Section, welcomed the delegates and introduced Walter F. Perkins, vice-president, Koppers Company, Inc., of Baltimore, who reviewed the industrial history of Baltimore.

The technical program, which consisted of subjects of general interest in the oil and gas power field, was well attended. Such subjects as design features of the Nordberg radial engine, principles of foundation design for engines and compressors, starting requirements of Diesel engines on locomotives, and analysis of the exhaust process in four-stroke reciprocating engines, were among the papers discussed. Two panel discussions, one on the question of "What Drive for Marine Propulsion?" and the other on "Heavy Fuels—How to Handle and Burn Them—Make Them Pay" attracted large audiences.

A welcome break came in the business proceedings on Wednesday when the entire group inspected the U. S. Naval Engineering Experiment Station at Annapolis, going and returning by boat as guests of the Koppers Company, Inc. A general vote of thanks was extended to Koppers for its generous hospitality on this occasion. Other inspection trips were made to the Koppers Company, American Hammered Piston Ring Division, and Baltimore Transit Company.

On Monday, June 12, preceding the conference proper, afternoon and evening sessions were devoted to lectures on corrosion, with John C. Gibb of Socony-Vacuum Oil Company acting as chairman. This was the third of a series of preconference lectures which have been so well received that the Division in executive session voted in the future to make these lectures an integral part of the Conference and to publish them in the proceedings.

At the close of the conference, outgoing chairman, L. N. Rowley, Jr., McGraw-Hill Publishing Company, Inc., New York, N. Y., received a vote of thanks for the splendid job he has done and surrendered the gavel to incoming chairman, T. M. Robie, Fairbanks, Morse and Company, Chicago, Ill.

The Tuesday night banquet was presided over by L. N. Rowley, Jr., who introduced toastmaster Marvin W. Smith, president, Baldwin Locomotive Works, Philadelphia, Pa. Rear Admiral David H. Clark, Chief, Bureau of Ships, Department of the Navy, Washington, D. C., was speaker of the evening, giving a history of Diesel engines in the U. S. Navy.

REAR ADMIRAL DAVID H. CLARK, CHIEF, BUREAU OF SHIPS, DEPARTMENT OF THE NAVY, ADDRESSING OIL AND GAS POWER CONFERENCE IN BALTIMORE, JUNE 13

R. TOM SAWYER (*left*) RECEIVING CERTIFICATE OF AWARD FOR HIS SERVICE AS CHAIRMAN, OIL AND GAS POWER DIVISION, FROM L. N. ROWLEY, JR., AT THE OIL AND GAS POWER CONFERENCE IN BALTIMORE, MD.

ASME Calendar of Coming Events

Sept. 18–22
ASME Instruments and Regulators Division Conference, Municipal Auditorium, Buffalo, N. Y.
(Final date for submitting papers was May 1, 1950)

Sept. 19–21
ASME Fall Meeting, Hotel Sheraton, Worcester, Mass.
(Final date for submitting papers was May 1, 1950)

Sept. 25–28
Petroleum Mechanical Engineering Conference, Hotel Roosevelt, New Orleans, La.
(Final date for submitting papers was May 1, 1950)

Oct. 23–25
ASME Fuels Division Conference, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers was July 1, 1950)

Nov. 26–Dec. 1
ASME Annual Meeting, Hotel Statler, New York, N. Y.
(Final date for submitting papers was Aug. 1, 1950)

April 2–5, 1951
ASME Spring Meeting, Hotel Atlanta Biltmore, Atlanta, Ga.
(Final date for submitting papers—Dec. 1, 1950)

April 17–19, 1951
ASME Process Industries Conference, Baltimore, Md.
(Final date for submitting papers—Dec. 1, 1950)

June 11–15, 1951
ASME Semi-Annual Meeting, Hotel Royal York, Toronto, Ont., Can.
(Final date for submitting papers—Feb. 1, 1951)

(For Meetings of Other Societies see page 675)

French Student Wins Rice Award

GILBERT RIOLLET of France, mechanical engineer and a June graduate of the School of Arts and Manufactures, Paris, France, is the recipient of the Calvin W. Rice Memorial Scholarship Award for 1950–1951, presented by the Woman's Auxiliary to The American Society of Mechanical Engineers. Mr. Riollet is interested in steam and gas turbines and in the application of jet propulsion and will study at Purdue University, Lafayette, Ind.

This year the Rice Scholarship has been increased to $750.

Opportunities

OVER one thousand opportunities for graduate study, teaching, or research abroad during the 1951-1952 academic year are available under the terms of the Fulbright Act, it was recently announced by the United States Department of State. Openings are available in Belgium, Burma, France, Greece, Italy, Luxembourg, The Netherlands, New Zealand, Norway, The Philippines, United Kingdom and Colonies, Australia, Egypt, India, Iran, and Turkey.

Grants usually include transportation, tuition, living allowance, and a small amount for necessary books and equipment.

For application forms, write to The Institute of International Education, 2 West 45th Street, New York 19, N. Y. Closing date is Oct. 15, 1950.

Fine Technical Library Serves Chicago

ASME RESIDENTS in the Chicago area are fortunate in having available the John Crerar Library which is one of the largest science and engineering libraries in the country.

A booklet "For Economy in Research" prepared by the Library gives an account of its collections, special services, and facilities available to individuals and companies. The Library is a privately endowed free public library established in 1894 by the will of John Crerar, a wealthy Chicago manufacturer.

The Library houses nearly three quarters of a million volumes of which some 55,000 are in engineering. Its current and historic files of scientific journals, both foreign and domestic, are noted for their completeness.

The library occupies the upper 11 floors of a building on Randolph Street at Michigan Avenue. Library hours are 9:30 a.m. to 9 p.m. on Monday and from 9:30 to 5:30 p.m. on other days except Sunday.

The rates for special research projects and translations are normally $4.25 per hour. The Library also maintains industrial memberships as a normal part of the Library membership program to supplement the endowment income. Such memberships vary from $100 to $1000 a year. These subscriptions can be used to cover library research projects authorized by industrial members.

Junior Forum

Society Leadership Joins Junior Members in PD Conference

A NEW kind of ASME meeting is evolving out of the work of the National Junior Committee.

This was apparent at the National Junior Conference on "What is Your P.D.?" held at the Semi-Annual Meeting in St. Louis, when thirteen junior members, each representing one of the Sections in Region VI, stood up one by one and commented on different aspects of professional growth as it affected them. The clarity of the statements, the sound judgments of these young men had a profound effect on members of the Council and other leaders who make up the "strong backbone of the Society," so much so, that D. Robert Yarnall, past-president and Fellow ASME, was moved to express pride that he was a member of an organization in which such a performance by its young men was possible.

Men of this type, he said, were the kind he wanted to see in his own plant. At meetings such as this, Mr. Yarnall continued, small manufacturers could find young engineers of talent. Recalling how he and Mr. Waring started the Yarnall-Waring Company of Philadelphia on a shoestring as young men just out of college, he stated that he shuddered now at their audacity. In a simple, moving statement, Mr. Yarnall expressed hope that some of the young members present would start their own business, for "no other success was so completely satisfying."

Other Conferences Planned

The Conference was the second of four planned by the National Junior Committee for 1950. The first, held at the Spring Meeting in Washington, D. C. (See pages 527–528 of the June issue) was a rewarding event for juniors representing Sections in Region III. A conference on the same subject is planned for the Fall Meeting at Worcester, Mass., and for the Annual Meeting in New York, N. Y.

Behind the idea of the Conferences is the farsighted generosity of the Old Guard Committee which, under the leadership of F. D. Herbert, conceived the plan of paying the expenses of one junior member from each Section of the Region in which each of the four national meetings were to be held in 1950. Building upon this financial support, the National Junior Committee selected a topic, invited speakers, and set up a simple plan whereby two veteran engineers would speak on professional development and would be followed by statements from each of the junior representatives on the same topic. In Washington and in St. Louis, this procedure resulted in a meeting in which age and inexperience intermingled so completely that the gulf that seems to be so stark a reality at most ASME meetings, disappeared. A family informality was created in which one junior acknowledged he found himself completely at home chatting with President Cunningham.

But the meeting just didn't happen to happen. First, it had the support of all members of the Council who made it a point to spend the remaining four hours of a long day in a hot room with young men of the Society. Second, as each member entered the meeting room he was introduced to the junior representatives and to other young men present. Third, in a moment of good fun, C. E. Davies and Don Jahncke, chairman, National Junior Committee, prevented a segregation by age by cajoling members of the Council and other distinguished leaders to break up and sit among the younger men. Fourth, two excellent talks, the first by I. T. Monseth, of Westinghouse Electric Corporation, St. Louis, Mo., reviewing what industry was doing to contribute to professional development of its engineers, and the second by C. M. Stanley, of the Stanley Engineering Company, Muscatine, Iowa, analyzing the basic factors of professional development, whose mastery was essential to professional maturity, provided an excellent springboard for comments by the junior representatives.

But it was the caliber of the junior representatives who came prepared to maintain full command of a meeting planned to shed light on their own needs and aspirations and to expose their own talents, which made the meeting such a new and hopeful experience for older members of the Society.

Guest of Old Guard

The Junior representatives were: *Central Indiana*, John J. Huron, Indianapolis, Ind.; *Central Illinois*, David W. Atkinson, Peoria, Ill.; *Central Iowa*, Paul W. Latham, Newton,

AT THE CONFERENCE SPONSORED BY THE JUNIOR AND EDUCATION COMMITTEE

(*Left to right:* C. M. Stanley, A. J. Snider, 3rd, and I. T. Monseth.)

Iowa; *Chicago*, L. A. Evers, Chicago, Ill.; *Fort Wayne*, R. V. Huffman, Decatur, Ind.; *Iowa-Illinois*, Marvin H. Linn, Moline, Ill.; *Louisville*, Lawrence S. Churchill, Louisville, Ky.; *Milwaukee*, Robert J. Booker, Milwaukee, Wis.; *Minnesota*, Daniel J. Greenwald, Jr., St. Paul, Minn.; *Nebraska*, R. W. Mills, Lincoln, Nebraska; *Rock Valley River*, Henry F. Peterson, Rockford, Ill.; *St. Joe Valley*, Joseph L. Nemeth, So. Bend, Ind.; and *St. Louis*, S. M. Murray, St. Louis, Mo.

A. J. Snider, 3rd, Jun. ASME, Combustion Engineering Superheater, Inc., Chicago, Ill., who was responsible for arranging for speakers and liaison with the ASME Education Committee, cosponsors, was chairman. He introduced D. H. Jahncke, chairman, National Junior Committee, who reviewed the work and plans of his group.

Industrial Training Programs

Beginning with a review of industrial training programs, Mr. Monseth set the discussion on firm ground by providing a perspective in the history of graduate training in industry. The first such courses were introduced about 1900 but the greatest progress, he reported, was made since 1932 when the Engineers' Council for Professional Development was established. Many companies recognized that continued education in industry was a responsibility of industry because the competence of its engineers was its greatest asset. About 15 industrial areas have well-established graduate-training programs sponsored by local industries and universities. In smaller communities where such facilities are not available or not now organized, the professional societies had an excellent opportunity, he declared, to aid some companies to meet the need. Self-initiated training programs are difficult ventures for young men. They need aid and encouragement to sustain them.

The ultimate aim of professional development, Mr. Monseth concluded, was a man who had the capacity to act and think as an individual.

An Individual Responsibility

Continuing the theme of individual responsibility for professional competence and active citizenship, Mr. Stanley offered the young men nine points as guide posts to professional maturity. Five of these were in the field of engineering and four were the universal attributes of the educated man. Not only did he comment on each, but he assigned numerical values to each point and asked the audience to make a personal audit as he described them. Those who received the perfect score of 20, were invited to leave. There was nothing more of advice that he could give them, Mr. Stanley said.

The nine points follow. One through eight have a maximum evaluation of two and point nine a maximum evaluation of four.

1 Continuous development of your technical specialty. Are you learning more and more about your job?

2 Knowledge of your company's policy. Do you know all about your company's business? How and why it is and does?

3 Broadening your engineering foundation. Do you read about trends and developments in fields outside your specialty?

4 Knowledge about the engineering profession. Do you know what ECPD and EJC are and what they are doing? Does unity of the profession mean anything to you?

5 Engineering registration. Are you registered? Are you taking proper steps to become registered?

6 Communication skills. Do you take every opportunity to improve your ability to write lucidly and to speak publicly?

7 Human relations. Are you improving your knowledge of human relations and developing your skill to use them to your advantage in working with people?

8 Basic social and economic problems. Do you know the cause and effect relating to social and economic problems which motivate the economic life of your country?

9 Participation. Do you carry your share of the load in the life around you—in your community, professional society, church?

The Juniors Speak

Mr. Atkinson, representing the Central Illinois Section, was impressed by the guidance value of Mr. Stanley's nine points. He suggested that the Junior Committee use them in giving direction to future programs.

Mr. Churchill of the Louisville Section, said he was disturbed by an unsound attitude so often encountered among his fellows. To Mr. Stanley's nine points, he wanted to add a tenth: Attitude. Do you get things done? Do you judge your worth to your employer by what you actually produce?

Mr. Mills, of the Nebraska Section, directed the discussion to the young man who finds himself in a small community, virtually isolated from other professional engineers. What aids are available to such a man, Mr. Mills asked?

A plea for more responsibility sooner in a graduate engineer's career was made by Mr. Huron of the Central Indiana Section. The right to learn by making mistakes encourages initiative and develops resourcefulness, he claimed.

Mr. Huffman, of the Fort Wayne Section, said the junior who found himself weak on Mr. Stanley's points 3 and 4, should engage in professional-society work and benefit by the associations created by such activity. In a professional society away from the immediate responsibility of the job, young men and old can exchange ideas on professional matters in an atmosphere of leisure and good fellowship.

For Paul Latham, of the Central Iowa Section, the conference was a stimulating new experience. It enabled him for the first time to attend a national Society meeting. He was deeply appreciative of the privilege accorded him by the Old Guard Committee.

Commenting on Mr. Monseth's talk, Mr. Murray of the St. Louis Section, cautioned members in charge of industrial training programs about allowing such programs to become stereotyped. He questioned the value of such training in an organization which emphasizes details of a program rather than the personalities of those for whom the program is designed.

Mr. Peterson, of the Rock River Valley Section, spoke highly of the inspiration, the new ideals, the high standards of performance which can come out of the Junior Conferences. When the representatives report what they saw and heard in St. Louis, an audience much larger than the one present would benefit by the discussions, he said. In a shy reference to the kind of recognition that means something at the grocery store, Mr. Peterson spoke up for more flexibility in job classifications.

The final comment from a junior representative came from Mr. Evers of the Chicago Section, and was framed as a question. What was industry doing about the nongraduate engineer who has developed high competence in a narrow field? Would industry promote him in preference to the graduate whose training wa broad and whose industrial experience was cut short by military service?

Replying to Mr. Evers, Mr. Monseth stated emphatically that industry has learned from experience the value of the graduate engineer and backs him because of his good foundation for growth. The complexity of American industrial life, Mr. Monseth added was making the self-made man a rarity.

It was a right good "prayer meeting!"

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th St.

Chicago
84 East Randolph Street

Detroit
100 Farnsworth Ave

San Francisco
57 Post Street

MEN AVAILABLE[1]

MECHANICAL ENGINEER, BME, June, 1950, some airplane-mechanic, machine-shop experience. Some strain-gage work in college. Prefers design or stress analysis. Me-743.

MECHANICAL ENGINEER, candidate master's ME, also BS applied mathematics. Two years' experience analysis, development of servomechanisms. Advanced study of thermodynamics, heat transfer, air conditioning, vibrations. Desires interesting position. Me-744.

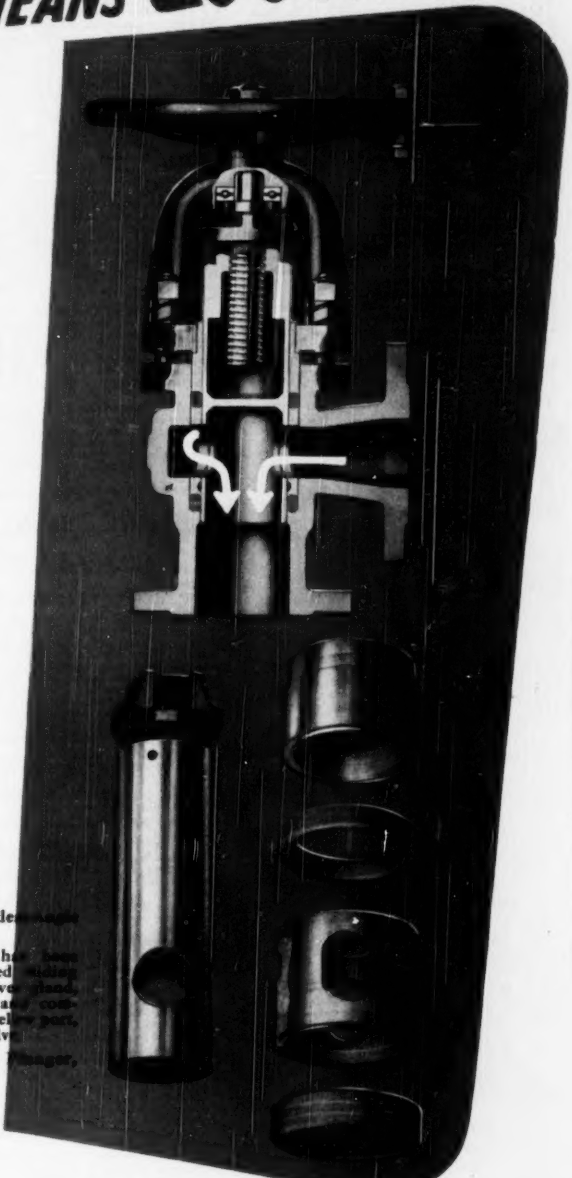
MECHANICAL ENGINEER, BME, recent graduate, 26, ex-Air Force officer. Desires responsible position with promising future. Interested in research, testing, development, power, heat transfer, or design. Location open. Me-745.

[1] All men listed hold some form of ASME membership.

(*ASME News continued on page 694*)

SEATLESS MEANS ECONOMY

IN BOILER BLOW-DOWN SERVICE



Because they eliminate the commonest source of trouble and expense in ordinary blow-off valve service, Yarway *Seatless* Blow-Off Valves mean real economy to boiler plant operators. *Yarways have no seat to score, wear, clog and leak.* Lubrication is usually the only maintenance they require.

Yarway introduced the seatless principle with the balanced sliding plunger many years ago . . . has constantly improved and adapted it to meet modern service requirements. Mechanical and metallurgical research in Yarway's own Steam Laboratory anticipates changing conditions . . . keeps Yarway valve design ahead.

There is a Yarway Seatless Blow-Off Valve for every pressure. Iron body for 50 to 200 lbs., steel body for higher pressures.

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(Above)—Cross section of Seatless Angle Valve, flanged.

OPERATION: After valve has been closed, shoulder on balanced sliding plunger contacts upper follower gland, forcing it down into body and compressing packing above and below port, making an absolutely tight valve.

(Below)—Balanced Sliding Plunger, Packing Rings and Glands.

YARWAY BLOW-OFF VALVES

PROCESS-EQUIPMENT MECHANICAL ENGINEER, 36, now reporting to president of manufacturer chemical equipment. Thirteen years' experience includes chemical industry and high pressure. ME, honor graduate leading university. Me-746.

MECHANICAL ENGINEER, master's, Yale, June, 1950, 24, married. Fourteen months' experience in heating and ventilating. Desires position in either heating and air-conditioning design or machine design. Will relocate. Me-747.

MECHANICAL ENGINEER, 23, BSME, SMU, 1949. Experience in oil field, machine shop, foundry (nonferrous) construction, farming. Desires position in foreign country or extensive travel. Central or South America preferred. Me-748-435-C.

MECHANICAL ENGINEER, 30, married, BSME; eight years' experience, including assistant foreman machine shop; industrial methods; production engineering; research and development with nationally known paper converter. Desires change; more responsibility. Metropolitan area. Me-749.

JUNIOR MECHANICAL ENGINEER, 26, BME, one year teaching thermo and lab. One year graduate studies. Desires any ME work, with preference for heat-power. New York City. Me-750.

MECHANICAL ENGINEER, 30, married, BME, seven years' experience production and proposition engineering with manufacturing concerns, including preliminary design to final product approval. Desires position with opportunity for advancement and responsibility. Me-751.

INDUSTRIAL ENGINEER, 24, veteran, conscientious and determined, receiving MSIE, August, Penn State. Two years' experience in manufacturing and research. Prefers position within 50-mile radius of Philadelphia, Pa. Available immediately. Me-752.

MECHANICAL ENGINEER, 35, background in business-machine field, twelve years' experience in administrative, research, noise-reduction engineering, development, machine and product design, testing, manufacturing methods, materials, and shop practices. Desires executive level as administrative or chief engineer, and possibly plant management. Me-753.

MECHANICAL ENGINEER, graduate, 27, family, employed; six years' experience in responsible position in design, production, operation of air conditioners, desires permanent engineering-department position with medium-sized company producing mechanical products or air conditioners in New England, New York, or New Jersey. Me-754.

POSITIONS AVAILABLE

MAINTENANCE ENGINEER, 30-35, mechanical graduate, five years' experience in installation of machinery and maintenance of equipment in rolling mill, paperboard, or other heavy industry, to supervise maintenance in rubber-manufacturing plant. Midwest. Y-3697D.

PRODUCTION ENGINEER, 32-40, mechanical or industrial degree preferred, industrial engineering and production-control training essential. Must have at least ten years' work experience, with minimum of five years' experience in industrial engineering, production control, or production engineering. Must have supervisory ability in at least one of these fields. Experience in metal-working industry essential, cold-heading experience desirable. Must be capable of co-ordinating production, wage incentives, and processing, with production foremen and supervisors; also of co-ordinating these functions with sales and cost personnel. $7000-$10,000. East. Y-3719.

TIME-STUDY SUPERVISOR, broad experience in machine shop, stamping, assembling, to supervise staff for electromechanical instrument manufacturer. $5500-$6000. Southern Conn. Y-3729.

EXECUTIVE PLANNING AND LAYOUT ENGINEER to plan, lay out, and install new machinery; will also be expected to purchase machinery, particularly along the lines of stamping, screw machines, heating and plating machines for small-parts manufacture such as instruments, watches, etc. $8000-$10,000. New England. Y-3751.

CHIEF MECHANICAL DESIGNER, 30-40, preferably graduate mechanical engineer; special study in communications and electronics desirable. Supervise 25 to 40 designers and draftsmen and responsible for development and design of all radio mechanical parts and related equipment; co-operate with sales department in preparation of new equipment specifications and in negotiations concerning equipment to be sold; conduct field tests on mechanical aspects of equipment and trouble shooting of customer installations; previous experience as chief or assistant chief design engineer in a manufacturing company with a wide range of design work where cost considerations and economy of space were of great importance. Volume-production experience most essential. Salary open. New York State. Y-3756.

CHIEF MECHANICAL ENGINEER, 40-55, with at least ten years' experience in industrial construction, particularly mechanical trades such as heating, plumbing, and air conditioning. $7000. Northern New Jersey. Y-3758.

CHIEF ENGINEER, 35-45, with mechanical degree, and preferably with a chemical-engineering degree as well. Experienced in a process industry, preferably chemical. Will be responsible for the entire engineering department in the plastics division of a nationally-known company. $10,000-$12,000. Midwest. Y-3780.

ASSISTANT PLANT ENGINEER, 35-38, mechanical degree, responsible for supervising the maintenance of all plant facilities and equipment and the development of new equipment for manufacturer of base and fabricated nonferrous products. Previous experience as plant engineer, assistant plant engineer, or master mechanic with heavy industry background in metal processing. $10,000. Midwest. Y-3797.

GENERAL SALES MANAGER, 35-45, mechanical graduate, with several years' experience in the conveyer and materials-handling industry or experience with industrial equipment or machinery, preferably spent in sales with an understanding of the engineering and manufacturing problems involved. Will be responsible for the development of an effective sales organization, and the distribution and sale of standard equipment for manufacturer of power-driven conveyer systems and materials-handling equipment. $20,000-$25,000. East. Y-3818.

FACTORY MANAGER, 42-52, mechanical graduate, with at least ten years' managerial experience covering supervision of machine shop, foundry, assembly, and test of power-plant accessories and industrial equipment. Must have excellent record covering labor and industrial relations. $10,000-$12,000 plus bonus. New York, N. Y. Y-3828.

SAFETY ENGINEERS, up to 40, with three years' or more experience with metalworking and manufacturing field on safety work, hydraulic presses helpful. Automobile manufacturing. Safety engineering on automotive manufacturing. Manufacturer of autos. $4200-$6000. Michigan. D-5727.

INSTRUCTOR OR ASSISTANT PROFESSOR, under 34, master's degree required; PhD preferred. Some industrial experience desirable, teaching experience preferred, but not essential. Able to instruct in the materials testing and engineering materials, heat engineering, machine design, and mechanical drawing for a university. $3300-$4400 for nine months. Northwest United States. R-6620.

ASSISTANT ADMINISTRATION ENGINEER, 28-38, basic engineering or physics education with extra work in business administration. Must have ability to deal with high-level scientists and research workers. Knowledge of personnel and purchasing. Informed about engineering research office procedures. Administrative duties for engineering research organization. $4800-$6000. Illinois. R-6622.

FOUNDRY SUPERINTENDENT, good practical and supervisory experience, including knowledge of cylinder heads for a manufacturer. Salary open. Midwest. R-6624.

DEVELOPMENT ENGINEER, mechanical or electrical graduate, 30-45, experienced in original development and design works on heavy automatic machinery. Desirable that candidate have one or more machinery patents to his credit. $5400-$7200 plus benefits. Illinois. R-6627.

MECHANICAL ENGINEER, 21-50, graduate, minimum of five years' experience on steam power-plant design, heating, ventilating, power piping design, specification writing, and preferably some field experience. Experience in a railroad-engineering department desired. Will be responsible for the preparation of preliminary studies, delineations, and cost estimates, complete working drawings, specifications, and details. Must be U. S. citizen. Must pass rigid physical examination. $7134. Alaska. Y-3859.

MAINTENANCE SUPERINTENDENT, 35-48, mechanical or chemical engineer, with five years supervisory work, maintenance-construction, process-plant equipment and buildings. Knowledge of product design; informed about production problems. Take charge of maintenance-construction of buildings, processing equipment, and power plant for a food-product manufacturer. $8000-$9000. Southern Ill. R-6648.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Aug. 25, 1950, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ALLEN, EDWARD HENRY, MacKenzie, British Guiana
ANTHONY, WILLIAM J., Elkton, Va.
BADGER, WARREN, Fairmont, W. Va.
BECKNELL, R. V., Ridgewood, N. J.
BEEKMAN, MYRON C., Royal Oak, Mich.
BERKOWITZ, HAROLD, Brooklyn, N. Y.
BERTHELSEN, VIGGO, Joliet, Ill.
BISWAS, BIMALENDU N., Dartford, Kent, England
BOEKHOFF, WILLIAM F., Whiting, Ind.
BONNER, CEDRIC M., JR., Canton, Ohio
BORCHARDT, ROBERT E., Rockford, Ill.
BORDA, NICHOLAS B., Lomas de Chapultepec, Mexico, D. F. (Rt)
BRAVERMAN, JERRY, Philadelphia, Pa.
BROKER, WALTER C., New York, N. Y.
BUEHRER, ERWIN, Schaffhausen, Switzerland
CARPENTER, RALPH P., Indianapolis, Ind.
CORDIER, LEE G., JR., Drexel Hill, Pa.
CRISSMAN, GLENN P., Detroit, Mich.
CULVER, HENRY F., Chicago, Ill.
CUTLER, MICHAEL M., Hagerstown, Md.
DAHLEN, PAUL A., N. Canton, Ohio
DAVIS, A. L., Schenectady, N. Y.
DEAN, LYLE A., Walnut Creek, Calif.
DETTENMAYER, HENRY C., Milwaukee, Wis. (Rt & T)
DENARI, EDWARD J., Chicago, Ill.
EKHOLM, ROBERT L., Overland, Mo.
EDELEN, J. T., Bethel, Ohio
FARUQUI, GHAYASUD DIN, Karachi, Pakistan
FELLOWS, WILLIAM EDWIN, Schenectady, N. Y.
FICKS, WILLIAM G., Pittsburgh, Pa.
FOHL, HARRY A., Coatesville, Pa.
FRANKENBERG, RODERICK A., Pittsburgh, Pa.
FUCHS, WARREN, New York, N. Y.
GOOD, PAUL FREDERICK, Baltimore, Md.
GRAIFF, G. L., Samoa, Calif.
GRANACK, ANDREW PHILLIP, Hammond, Ind.
GROSS, HERBERT C., JR., Philadelphia, Pa.
GUTHRIE, WILLIAM S., College Station, Texas
HADJIS, JOHN, Lafayette, Ind.
HEILMAN, FRANK A., Oak Ridge, Tenn.
HEMKE, P. E., Troy, N. Y.
HENDERSON, C. ROBERT, Detroit, Mich.
HENRIKSEN, ERIK K., Ithaca, N. Y.
HETU, THOS. P., Pine Meadow, Conn. (Rt)
HORNER, EDWARD A., N. Sacramento, Calif.
HOUSER, PERRY L., Chicago, Ill.
HUDSON, JAMES A., S. Charleston, W. Va.
HYDEN, EUGENE B., JR., Chattanooga, Tenn. (Rt & T)
IRWIN, EUGENE D., Cedar Rapids, Iowa
JESSOP, STEPHEN W., Detroit, Mich.
JORDAN, CHARLES E., Omaha, Neb.
JORDAN, JACOB, New Castle, Pa.
JOSHI, M. K., New York, N. Y.
KADAM, BHAURAD Y., Belgaum, Bombay Province, India
KESSLER, NORMAN H., Cedar Rapids, Iowa
KLECK, CARL F., Lombard, Ill.
KURTZWEIL, TERRENCE J., Alliance, Ohio
LAMOTTE, FERDINAND, III, Louisville, Ky.
LAVERTY, NORMAN P., Santa Monica, Calif.
LIVINGSTON, PETER A., Niagara Falls, Ont., Can.
LOBEL, ROBERT A., Notre Dame, Ind.
LUHRS, JOHN F., Schenectady, N. Y. (Rt & T)
LYON, FRED H., Potsdam, N. Y.
MACISAAC, JAMES J., Detroit, Mich.
MALONE, FRANK J., Rio de Janeiro, Brazil
MANAGO, JOSEPH B., JR., Columbia City, Ind.
MILLER, FRED A., Wilmington, Del.
MYLANDER, LEIF, New York, N. Y.
NAVE, HOYT H., La Guaira, Venezuela
NEILD, A. BAYNE, JR., Annapolis, Md.
NEWMAN, OTTO J., Baltimore, Md.
NOVY, RAYMOND F., Riverside, Ill.
OBERG, JAMES L., New York, N. Y.
O'CONNOR, JOHN M., Evanston, Ill.
OLEJER, ANDREW J., Belleville, N. J.
PACE, CHARLES W., Hammond, Ind.
PHILLIPS, WILLIAM H., Bethesda, Md.
PRUNTY, ROBERT E., Rapid City, S. Dak.
RHODES, KEITH H., Laramie, Wyo.
RICE, HAROLD W., Los Angeles, Calif.
ROBERTS, GLYNN W., Schenectady, N. Y.
ROBERTS, WILLIAM H., JR., New York, N. Y.
ROSENBERG, ALAN S., Maplewood, N. J.
RUCKER, HORTON B., Atlanta, Ga.
SHAFFER, EDWIN CLINTON, Detroit, Mich.

(*ASME News continued on page 696*)

Siegel, Stanley, Bronx, N. Y.
Sinden, Alfred D., Aurora, Ill.
Sligar, James K., St. Louis, Mo.
Smith, George L., Jeffersonville, Ind.
Smith, Paul C., North Hills, Pa.
Snyder, Elwin L., Weslaco, Texas
Snyder, F. Clayton, Wesleyville, Pa. (Rt)
Snyder, Warren E., Minneapolis, Minn.
Socher, Bernard, Los Angeles, Calif.
Spear, R. Dixon, Great Neck, N. Y.
Sullivan, James J., Fall River, Mass.
Sutton, Walter G., Jr., Los Angeles, Calif.
Van Aalst, Johnann H. W., Glendale, Calif.
Van Cleve, Earl H., Camden, N. J.
Waldstein, Joseph, Chelsea, Mass.
Weber, Carl Frederick, Rochester, N. Y.
Weber, William R., Juneau, Alaska
Werapermall, Denzil N., Nugegoda, Ceylon
Wiggs, B. R., Jr., Chattanooga, Tenn.
Wood, William D., Schenectady, N. Y.

CHANGE IN GRADING

Transfers to Member and Associate

Arly, Waldemar P., Salt Lake City, Utah
Besio, Charles A., Dallas, Texas
Brearley, Wm. H., Jr., Philadelphia, Pa.
Fitzke, William O., Canton, Ohio
Grossman, Jacob, New York, N. Y.
Gubitose, Nicholas F., Scranton, Pa.
Hackney, E. W., Fort Wayne, Ind.
Kern, Frank, Jr., Detroit, Mich.
Klespies, Frank J., Akron, Ohio
Mikrut, Stanley, Yonkers, N. Y.
Plamann, John August, W. St. Paul, Minn.
Lewis, John L., Philadelphia, Pa.
Smith, Ronald C., Clifton, N. J.
Timms, Howard L., Racine, Wis.
Tolman, Raymond H., Westboro, Mass.
Tomkins, Stanton E., Ann Arbor, Mich.
Vane, Francis F., Rockville, Md.
Webstrom, David B., Wilmington, Del.
White, A. O., Jr., Atlanta, Ga.
Zavodny, Stephen, Rockledge, Pa.

Transfers from Student Member to Junior.........400

Obituaries

James Ellsworth Boyd (1863–1950)

James E. Boyd, professor emeritus of mechanics, Ohio State University, died at his home in Columbus, Ohio, May 10, 1950. Born, Muskingum County, Ohio, Nov. 6, 1863. Parents, Joseph and Susan Lavina (Riley) Boyd. Education, BS, Ohio State University, 1891; MS, Cornell University, 1896. Married Emma Clark Wells, 1893 (died 1942). Received Lamme Medal from Ohio State University, 1938.

Author of "Mechanics," "Strength of Materials," and "Differential Equations"; wrote many technical papers. Mem. ASME, 1915. Survived by two children, Orton Wells Boyd, Chevy Chase, Md., and Dorothy May Boyd, Columbus, Ohio.

Walter Rodney Cornell (1882–1950)

W. Rodney Cornell, professor, mechanics of engineering, Cornell University, died May 27, 1950. Born, Vineland, N. J., July 19, 1882. Parents, Hunter and Agnes Lydia (Judson) Cornell. Education, BS, Rutgers University, 1907; CE, Cornell University, 1915. Married Edna G. Tree, 1911. Mem. ASME, 1925.

William Langdon Dearborn (1867–1950?)

William L. Dearborn, whose death was recently reported to the Society, was a retired mechanical engineer. Born, Boston, Mass., Feb. 1, 1867. Parents, John Langdon and Sarah Abbot (Smith) Dearborn. Education, mechanics arts and civil engineering, Massachusetts Institute of Technology, 1888. Married Ellen Eustis, 1904; children, Langdon and Eustis. Jun. ASME, 1892; Mem. ASME, 1917.

Andor de Bodor (1881–1950)

Andor de Bodor, consulting engineer, Associated Engineering Co., Newark, N. J., died in January, 1950. Born, Budapest, Hungary, Nov. 25, 1881. Education, ME, University of Budapest, 1912. Married Rose Sterner, 1911; children, Violet and Pearl. Mem. ASME, 1946.

Jerry Jay Dunn (1874–1950)

J. Jay Dunn, retired 1946 as assistant to the vice-president, National Tube Co., Pittsburgh, Pa., died at his home in Ellwood City, Pa., May 9, 1950. Born, Marysville, Ohio, Sept. 30, 1874. Parents, Jeremiah Mason and Harriett A. (Snyder) Dunn. Education, attended Ohio State University; honorary DS, Geneva College. Married Martha Denman, 1896. Received a medal from the King of Belgium, 1919, for services rendered during World War I. Mem. ASME, 1917. Survived by wife, two sons, John J., Moneterey Park, Calif., and Eric, Baltimore, Md.; two daughters, Mrs. E. C. Wright, Tuscaloosa, Ala., and Mrs. Robert A. Laedlein, Pittsburgh, Pa., and four grandchildren.

Herbert Vrooman Ennis (1884–1950)

Herbert V. Ennis, retired engineer, died Feb. 14, 1950. Born, Paterson, N. J., June 6, 1884. Parents, William C. and Kate E. Ennis. Education, high-school graduate; Polytechnic Institute of Brooklyn. Jun. ASME, 1910; Mem. ASME, 1921.

George Grant Guthrie (1904–1950)

George Grant Guthrie, project engineer, Burns and Roe, Inc., New York, N. Y., died at his home in Westfield, N. J., May 3, 1950. Born, Rochester, N. Y., Feb. 29, 1904. Parents, John Bell and Maude Alice Guthrie. Education, ME, Cornell University, 1926; MME, 1933. Married Beryl Ruth Haney, 1928. Received McGraw Prize, 1935. Mem. ASME, 1937. Survived by wife, a son, John; three daughters, Nancy, Sally, and Wendy; and his mother.

Robert Roy Robertson (1883–1950)

Robert R. Robertson, retired engineer of design and construction, Los Angeles Bureau of Power and Light, died May 17, 1950, at his home in Los Angeles, Calif. Born, Albion, Mich., March 2, 1883. Parents, Mott Orville and Henrietta (Cool) Robertson. Education, BSME, Purdue University, 1907. Married Clara R. Gosma, 1909; son, John M. (missing in action, 1942). Mem. ASME, 1919. Served the Society as chairman, Los Angeles Section, 1932. Survived by wife, a brother, Clarence, and sister, Ada May.

David John Rowland (1880–1950)

David J. Rowland, partner, Rowland and Burns, mechanical and consulting engineer, New York, N. Y., died at Memorial Hospital, New York, N. Y., May 21, 1950. Born, Llantrisant, Glamorgan, Wales, Jan. 10, 1880. Parents, William and Eleanor (Williams) Rowland. Education, Pratt Institute. Naturalized U. S. citizen, 1921. Married Carrie Louise Jones, 1904. Mem. ASME, 1923. Survived by wife, a son, David J., Jr.; two daughters, Elizabeth L. and Ernestine E.; and a sister, Ernestine A. Rowland.

A. Camp Streamer (1885–1950)

A. Camp Streamer, former vice-president, Westinghouse Electric Corp., in charge of its East Pittsburgh (Pa.) works, died at his home in Forest Hills, Pa., on May 4, 1950. Born, Boulder, Colo., Nov. 23, 1885. Parents, Francis M. and Lula A. (Walker) Streamer. Education, BSEE, University of Colorado, 1907; honorary DE, 1946. Married Flora E. Goldsworthy, 1911; children, Flora Ethelyn and Douglas (deceased). Mem. ASME, 1943. Former president, National Electrical Manufacturers Association. Survived by wife, a daughter, Mrs. W. A. McChesney, Philadelphia, Pa.; a sister, Mrs. E. B. Place, Evanston, Ill., and two half-brothers, R. H. Durwood, San Antonio, Texas, and L. A. Durwood, Boulder, Colo.

William Edward Sullivan (1898–1950)

William E. Sullivan, captain, USN, commander, Puget Sound Naval Shipyard, Bremerton, Wash., died May 4, 1950. Born, Iron River, Wis., June 23, 1898. Parents, James Edward and Elizabeth (Nixon) Sullivan. Education, graduate, U. S. Naval Academy, 1920; MS, Columbia University, 1927. Married Marjorie Goodman, 1922. Received Legion of Merit for work in South Pacific and gold star for services at Pearl Harbor. Survived by wife and daughter, Naidah; a brother, J. A. Sullivan, International Falls, Minn., and two sisters, Mrs. C. L. Crandall, Dayton, Ohio, and Mrs. H. A. Anderson, Santa Rosa, Calif.

Killey Eldridge Terry (1883–1950)

Killey E. Terry, director of engineering, S. D. Warren Co., Cumberland Mills, Me., died April 1, 1950, in Portland, Me. Born, New Bedford, Mass., May 2, 1883. Parents, Killey Eldridge and Mary Terry. Education, graduate, Massachusetts Institute of Technology, 1906. Married Pauline Schumaker, 1914 (died 1948). Mem. ASME, 1914.

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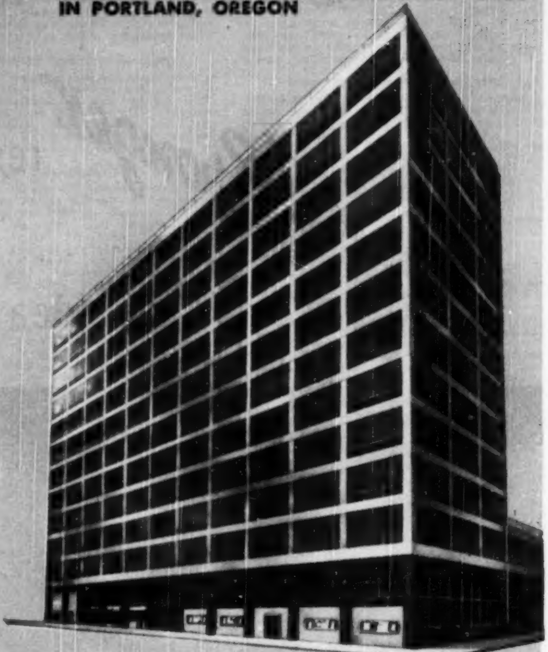
THE NEW EQUITABLE SAVINGS AND LOAN ASSOCIATION BUILDING
IN PORTLAND, OREGON



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The new Equitable Building in Portland, Oregon, presents an impressive array of "firsts" in ultra-modern construction.

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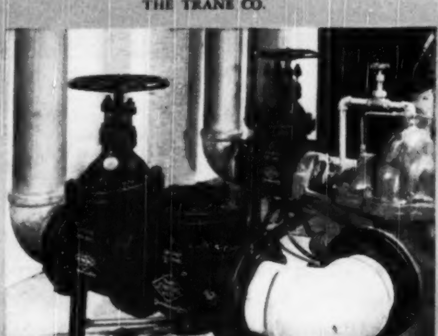
Mechanical Contractor: P. S. LORD

Air Conditioning System: THE TRANE CO.



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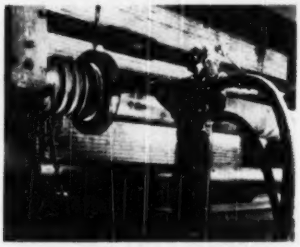
• NEW EQUIPMENT

Unique Device Makes First 30" O.D., Alloy Corrugated Piping

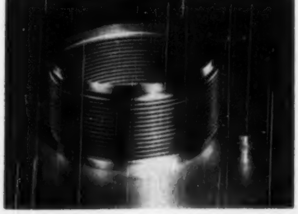
The first 30-inch O. D., chrome-moly, corrugated piping was recently formed on this unique device in the metal-fabricating shops of The M. W. Kellogg Co., refinery and chemical engineers of Jersey City, New Jersey.



Totalling some 90 feet over-all, eight pieces of this relatively large diameter pipe were shaped for the major part of the exhaust-steam line from a topping turbine in a main power station of a metropolitan utility in the East. (Note: Consolidated Edison's Hudson Avenue Station, Brooklyn, New York.)

Beyond physical size itself, the major problem in fabrication, according to Kellogg, was to preclude cracking, a defect much more apt to occur in forming chrome-moly than in working either carbon or carbon-moly steels. Through carefully controlled incremental heating and subsequent compression on this specially devised machine, the corrugations were made, giving the final corrugated piping five times the flexibility of plain piping.

Stainless Steel Bellows Now Available In Complete Range of Sizes



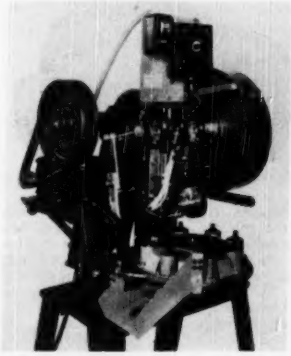
Chicago Metal Hose stainless steel bellows are available in a complete range of sizes. They are ideally suited where problems of pressure, high and low temperatures, and corrosion are factors. They are especially suited for applications of control devices and instrumentation, such as regulators, valves, steam traps, shaft seals, expansion connections and flexible connector for misalignment.

CMH stainless steel bellows are manufactured in single and multi-ply construction and various lengths, dependent upon application requirements.

Bellows or bellow assemblies with standard fittings or fittings to customer's specifications can be supplied. Fitting attachment may be attached by electrical circular seam welding to assure leakproof uni metal assemblies. For further information write Chicago Metal Hose Corp., 1308 South Third Ave., Maywood, Ill.

Snap-Switches Stamped "On" and "Off" With New Press Assembly

A new power press assembly for stamping commonly used molded plastic snap-switch levers with the lettering "ON" and "OFF" in white or other color is offered by Acromark–Elizabeth, N.J. Only the dial feed assembly is new, the heating head and color tape or foil feed having been previously announced for another adaptation.



The tape feed for hot stamping is, however, new in one respect, viz; a split tape or foil is fed from two feed rolls, one to hot stamp "ON" and one to hot stamp "OFF" in their angular positions. The hot stamping dies themselves are engraved in a "U" shape at an angle on face to match the switch lever.

The switch levers are placed in specially developed nesting fixtures (eight on the dial) which insure positive positioning and resultant perfect stamping. After each switch handle is hot stamped in white or other color, it passes toward succeeding stations of the dial and is knocked off and down a chute, two stations past the stamping position. This leaves ample time for the operator to load the switch levers at a speed of *3000* per hour or greater if press speed is increased.

Essentially, this new development is interesting for three reasons—1. It utilizes split tape for color marking in two postions at nearly right angles. 2. It shows how a precision nesting fixture can hold uniformly molded parts of special shapes in position for hot stamping in color. 3. It shows how simply a hot stamping assembly can be adapted to a standard power press.

For further information write—The Acromark Co., 345 Morrell St., Elizabeth 4, N.J.

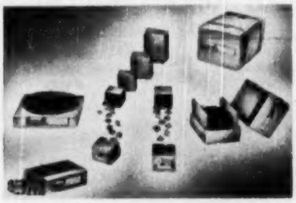
Morse Roller Chains and Parts Are Now Packaged

Effective at once, the Morse Chain Co. of Detroit, Mich. and Ithaca, New York, a division of Borg-Warner Corp., will package its complete line of Morse roller chains and parts—the first complete packaging program in the history of the industry.

R. J. Howison, general sales manager, said the costs of packaging will be absorbed by Morse completely.

Benefits of the new program will be felt primarily by Morse distributors and customers who have reported steady rises in handling costs, Mr. Howison said.

"In the future," he declared, "Morse products will come to them in individual, corrugated cardboard cartons, sturdily constructed and plainly labeled. Not only will this program expedite the shipping, storage and ordering of chains and parts, reducing handling costs to a minimum, but it also will simplify inventory problems."



Buyers and distributors of roller chains and parts in the past have been compelled to purchase or build special drawers and bins in order to handle the loose items, he said.

Roller chains and parts are dipped in a lubricant at the factory before shipment as a rust preventive, Mr. Howison said, pointing out that such items, unpackaged, attract and collect shredded paper or excelsior while in shipment, and dust and grime while in storage. "This problem also will be eliminated by Morse's new packaging program," he said.

Eighteen cartons of varying sizes have been designed to handle the complete Morse line, including standard quantities of individual links and roller chain in lengths of 5, 10, 50, and 100 feet. The cartons range in size from $2^1/_8" \times 2^3/_8" \times 1^1/_2"$ for links, to $19^1/_2" \times 19^1/_2" \times 3^1/_4"$ for roller chain.

Specially-designed, disposable reels, made of corrugated material and packaged in individual cartons, will be used for roller chains

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in 50- or 100-foot lengths. Four sizes of such reels and cartons have been designed, the largest being $9^3/_4''$ × $9^3/_4''$ × $24^5/_8''$, Mr. Howison said.

Roller chain from $^3/_8''$ pitch to $^3/_4''$ pitch to $^5/_4''$ pitch will be packaged in cartons designed for 5- and 10-foot lengths, and in enclosed reels with 50- or 100-foot capacities. Chain of 1″ pitch will be packaged in 5- and 10-foot boxes and 50-foot reels. Larger chains, up to $2^1/_2''$ pitch, will be packaged in 10-foot boxes.

Connecting, roller, and offset links of $^3/_8''$ pitch through 1″ pitch will be packaged 25 to a box. Larger sizes will be packaged in smaller quantities per box, depending upon size.

Each box or carton will feature an easily-read label giving the size and quantity of the contents, Mr. Howison said. Decisions on carton sizes were affected not only by standard lengths and quantities, but by weight, he said. The heaviest carton—containing a 10-foot coil of $2^1/_2''$ pitch roller chain—weighs 110 pounds.

A four-page pamphlet, describing the new packaging program in detail, can be obtained by writing the Morse Chain Co., 7601 Central Ave., Detroit 8, Michigan, and asking for folder F57-50.

G. E. Announces New Tri-Clad* Brake-Motor

General Electric is now offering its line of Tri-Clad motors equipped with Stearns magnetic brakes as unit apparatus, it was announced recently by the company's Small and Medium Motor Divisions.

All types of Tri-Clad motors up to 20 hp, 90 lb-ft static torque are available with the explosion-proof, electrically operated brake, a product of the Stearns Magnetic Manufacturing Co., Milwaukee.

The new compact brake-motor retains all the features of the standard Tri-Clad construction, it was said, and is for application on cranes, hoists, conveyors, machine tools, printing presses, laundry machines, etc. G. E. assumes unit responsibility for both brake and motor.

For flexibility, brake combinations are selected to operate at 100 and 150 per cent of full-load motor torque. A single adjustment nut sets the torque for specific load conditions, thus enabling operation below maximum rated torque whenever possible to conserve brake linings and lengthen brake life.

Brake linings are fabricated of high-friction material for long life without replacement, and in normal operation the only maintenance required is the simple screwdriver adjustment which compensates for wear. A wear indicator, viewed through a plastic window, tells when this is necessary. Manual release, a standard feature on the new G-E unit brake-motor, is easily accomplished by removing the plastic window which covers the combination hand release and wear indicator.

All brakes, even on open motors, are totally enclosed, and the brake cover is sealed to the motor housing providing protection from

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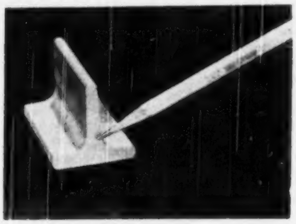
harmful atmospheres, dust, and dirt. To safeguard against accidental harm to personnel and equipment, the brake will continue to hold even if power fails during operation, it was said, because of its spring-set, solenoid-release design.
*Registered Trade-Mark

Inconel "T" Sections Made Available In Standard Size for High Temperature Equipment

Availability of hot rolled Inconel in equal "T" sections has been announced by The International Nickel Co., Inc. As produced at the company's Huntington, West Virginia Works, the "T" sections are made in a standard size $1^1/_2$ by $1^1/_2$ by $^1/_4$ inches, and in lengths up to 15 feet. The weight is approximately $2^3/_4$ pounds a foot.



The primary purpose of the new product is to provide manufacturers of furnaces and other high temperature equipment with ready-made and uniform structural parts at considerable economy over the cost of fabricating those parts in their own shops. The section can be welded, riveted, or otherwise joined without difficulty.

While production to date has been limited to Inconel, for which a wide market exists in industrial fields requiring high resistance to heat and where size requirements are more or less uniform, the sections can be produced in nickel and Monel where tonnage demands are sufficiently high in standard sizes. Low tonnage requirements in special sizes are not economical to roll.

The Inconel "T" sections will be carried in stock by distributors of Inco products throughout this country and Canada.

New Electric Fork Truck Offers Increased Speed, Capacity and Efficiency

A new electric battery-powered "Trucloader," 1000-pound fork-lift truck announced by Clark, has the following noteworthy features: (1) Automatically accelerated control as standard equipment—power controlled through a master switch, in turn controlled by an automatic timer, to provide

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even acceleration of motor speed. (2) Control is non-plugging type; direction of travel cannot be changed until motor comes to full stop. (3) "Dead man" brake operated off the drive shaft of the drive motor—sets automatically whenever the driver's seat is vacated. The directional control lever locks in neutral automatically when the driver leaves his seat. (4) Increased load capacity with 24 inch load-center rating. (5) 30 per cent higher speed, and (6) Maximum accessibility for easy service and maintenance.

An outstanding improvement claimed for the new machine is the use of a separate motor to provide power for the hydraulic pump. Result is an 80 per cent increase in lifting and tilting speeds over the former model. The lift-control lever is of new design, to permit foolproof identification and to operate in the same direction as the action desired—pull straight up to raise the forks, push down to lower the forks.

Similarly, the drive motor functions with greatly increased efficiency because it has nothing to do with the hydraulic system.

Uprights of rolled alloy steel, proved satisfactory on Clark's larger models, provide added strength to the lift assembly. Lift heights are available in a range from the standard of 84 inches, with overall height of 61 inches, to 130 inches and an overall height of 84 inches.

Steering mechanism is of new design for use with the pivoted type steering axle. Kickback is entirely eliminated.

Standard tires are demountable cushion type. Pneumatic and pressed-on solid tires are optional.

Full information on the new electric Trucloader may be had upon request to Clark Equipment Co., Industrial Truck Division, Battle Creek, Mich.

New High-Range Megger Insulation Tester

The higher and wider ranges now available in Megger Insulation Testers are extremely useful in several kinds of field tests, particularly in testing circuit breaker bushings, and in making time-resistance (dielectric absorption) tests on apparatus which has relatively high 10-minute insulation resistance values.

The extremely wide range of the new instruments is accomplished by two overlapping scales which results in an $8^1/_2$ inch scale length, as against $3^1/_2$ inches in the old instruments. A simple switch selects between one scale or the other without the use of a multiplier or divider.

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This new high range Megger instrument gives the maintenance engineer a simple, relatively inexpensive tool for detecting the deterioration in bushings. In the cases of some generators, transformers and cables with relatively high 1-minute insulation resistance values, which may increase with time during time-resistance tests, the instrument range should be high enough to permit this increase of resistance with time to be accurately observed.

These are only a few typical cases where these new higher and wider ranges offer decided advantages. The increased usefulness of these instruments will be reflected in applications in the field of preventive maintenance and production testing.

Our new 24-page Bulletin 21-20 will be sent on request to those who desire complete information. James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.

De Laval—IMO Rotary Pump

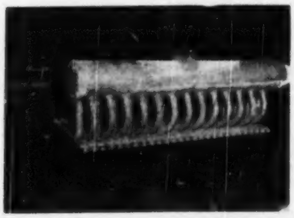
The new De Laval A313A IMO pump is a general service screw-type rotary pump designed for pumping petroleum products, and other light or viscous fluids as required for rotary and steam atomizing oil burners, oil transfer, lubrication, hydraulic systems and similar services. Capacities to 85 gpm . . . pressures to 150 psi. The bulletin contains a cross-section drawing, description of the IMO pumping principle, viscosity tables, dimension drawings and table of standard NEMA motor frame sizes. Main features of the pump include: Pulsation free flow. Pump can be mounted in any position and driven by direct connected shaft, V-belt or chain. Mechanical shaft seals. Pre-lubricated bearings. Optional types of mountings.

For further information write the Advertising Department, De Laval Steam Turbine Co., Trenton 2, N. J.

Unusual Temperature and Pressure in Mercury Boiler Call for Ingenuity in Tubing Construction by Babcock & Wilcox

Unusual conditions of temperature and pressure in a boiler unit when mercury vapor instead of steam is generated, called for ingenuity in the design and construction of two mercury boilers by The Babcock & Wilcox Co. for a new power plant operating on the mercury steam cycle with no separate steam boilers.

The plant, opened early this year, is the Schiller Station of the Public Service Co. of New Hampshire at Portsmouth and is the first mercury unit power plant in which there is no steam generated from the combustion of fuel. The plant was designed and built by the General Electric Co. The two B & W mercury boilers generate the mercury vapor and superheat the steam used in the cycle.



In the binary cycle mercury vapor is generated and produces power in a mercury turbine. The heat rejected from the mercury cycle produces steam which in turn generates power in a steam turbine. In the Ports-

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mouth plant each of the two mercury boilers serves its own 7,500 kilowatt mercury turbine and the steam produced by both serves a 25,000 kilowatt steam turbo-generator, making the installed capacity of the plant 40,000 kilowatts.

The mercury boilers are equipped for either oil or pulverized coal firing and convert liquid mercury to mercury vapor corresponding to the steam in a steam boiler unit. The mercury vapor passes through a mercury turbine driving an electric generator. In the mercury turbine the pressure and temperature of the mercury vapor is reduced and the mercury exhausts into a heat exchanger or condenser boiler which functions as a condenser in a straight steam plant. Due to the high temperatures corresponding to the low pressures of the mercury vapor, as compared to steam, the heat given up by the mercury vapor in this heat exchanger is at a high enough temperature level to produce steam in the condenser boiler. The heat given up by the mercury vapor, instead of being discarded as in the case with steam in the usual steam turbine condenser, in this binary cycle is absorbed by water in the condenser boiler and generates steam at a pressure of approximately 650 lbs. per square inch.

The steam generated by the condensing mercury in the condenser boiler is taken back to a superheater located in the combustion gas outlet of the mercury boiler where the steam is superheated to approximately 825 F. There are two mercury boilers, each serving a 7,500 kilowatt mercury generator, and the steam from each pair of the heat exchangers or condenser boilers returns to the superheater located in the mercury boiler serving that turbine. The superheated steam from the two superheaters, one in each mercury boiler, is combined and serves a 25,000 kilowatt turbo-generator. The steam part of the binary cycle is similar to any steam plant. This plant at design rating is expected to have a net heat rate of 9,200 Btu per kilowatt hour. The high fuel costs at Portsmouth are offset by the low heat rate of this cycle, and the plant is the most efficient of its size or installed capacity.

The temperature corresponding to the pressure at which the mercury vapor is formed in the mercury boiler dictates the use of materials which are suitable for the stresses encountered under these temperature conditions. The mercury drum and the wall headers which are not exposed to the fire are of SA-280 $^1/_2$ chrome. The wall tubes which are exposed to the fire are of Croloy 5 Si.

The furnace is completely mercury cooled by walls of tubes on approximately $1^3/_4$" centers. As the specific volume of mercury changes rapidly with increase in temperature and the formation of mercury vapor, the diameter of the tubes is successively increased. The front and rear walls, for instance, are $1^1/_2$" O.D. by $^7/_8$" I.D. at the bottom, increasing to $1^5/_8$" O.D. by 1" I.D. and finally to $1^{11}/_{16}$" O.D. by $1^1/_8$" I.D. at the top. The side walls increase from $1^3/_8$" O.D. by $^3/_4$" I.D. at the bottom to $1^1/_2$" O.D. by $^7/_8$" I.D. at the top.

This is accomplished by welding the required size tubes together to form a long tube with varying inside diameter. These tubes are joined to the top and bottom headers by welding.

All the tubing for the boilers was fabricated at the Beaver Falls (Pa.) plant of The Babcock & Wilcox Tube Co. and the welding job was done at the B & W shops at Barberton (Ohio) where excellent facilities and metallurical controls are available.

Side walls were formed of five similar sections, each consisting of 28 tubes. These

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plattens of tubes were set up in jigs in the shops for welding to the wall headers, and the entire platten was shipped as a unit to the job site.

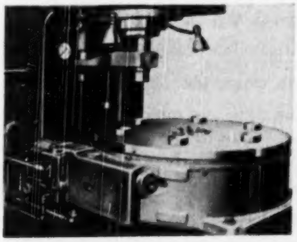
The front and rear walls were similarly formed, each of four sections of 32 tubes, shop welded to provide for the continuously increasing side diameter, and were welded to the bottom header in the shops. At the top of the front and rear walls these tubes form a convection heat exchange bank called the fog bank, the tubes of which are joined to the mercury drum.

The top side wall headers are connected to the mercury drum through outside vapor lines.

The mercury drum is provided with six large downcomers which are connected to the supply system feeding the lower header of each front, rear and side wall section.

New Large Hydraulic Index Table Announced by Denison

To meet the continuing demand for higher-speed, automatic feeding and ejecting equipment for faster-moving production lines in all industries, The Denison Engineering Co. of Columbus, Ohio, is now making a 33" automatic Index Table (with 24" work-circle) that can be used on either their 35-ton Multipress or other makes of equipment. It is hydraulically powered, provides variable speeds for any preselected indexing rate from 10 to 70 indexes per minute, and positions the dial with an accuracy of plus or minus .002". When installed on the Multipress, it is powered by the pumping unit of the press through the control system of the press. The table can also be operated by a small auxiliary pumping unit when used with other than hydraulic equipment.



A completely self-contained accessory, the table is available in 6 and 12 station types. It operates from, and in positive sequence with, the action of the press ram through the control system of the hydraulic power unit. This provides positive interlock. The ram cannot descend while the table is in motion, and the table will not rotate until the ram has completed its cycle. Also, since operation is automatic, the operator can stand well away from the press ram as an added safety factor.

An important feature of this new Index Table is said to be a positive looking device that holds the dial firmly in place at each station. The connecting linkage between driver and locking mechanism releases the locking pin as the table prepares to rotate through each cycle.

The tooling stations are accurately located about the circular dial. The dial is rotated and indexed by a Geneva arbor drive mechanism. This mechanism is actuated by a variable speed Denison fluid motor, powered by the Multipress pumping unit. The fluid motor and a speed-sequence valve are flange mounted to the left rear of the table. A simple knurled knob adjustment on the valve

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permits regulating the rate of table travel. Speed, in a stepless range, can be changed while the table is in motion.

Operations of the Multipress and Index Table combination can be made completely automatic by use of automatic hopper feeds and automatic ejection devices. Some typical ways of automatically ejecting finished work from the table tooling include mechanical brush-off, push-out, or punch-through, and air pressure, with air valves actuated by downstroke of the press ram. A cam track can be provided under the table dial, permitting various cam arrangements for automatic ejection of parts, or for raising or lowering ejection tooling.

A built-in "skip-station" accessory is available on this model of Index Table. It permits hurdling from one to five stations without loss of time at each idle station. This is reported to be a particularly desirable feature for short production runs or when tooling size limits the number of stations that can be used on the dial.

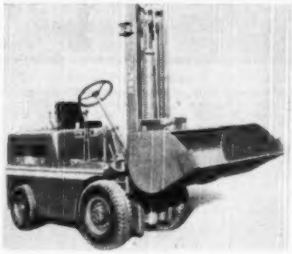
According to the manufacturer, the Index Table with Multipress provides a combination that is adaptable to many different production jobs in large or small shops and in all types of industries. The index table is applicable to operations and equipment other than those normally associated with press work.

Complete data is available from The Denison Engineering Co., 1171 Dublin Road, Columbus 16, Ohio.

New Hydraulic Shovel Attachment Speeds Handling, Eliminates Shocks

A scoop shovel attachment for fork-lift trucks, designed for full hydraulic operation through the cycle of picking up a load, tilting back for carrying, dumping and return to scooping position, is announced by the Industrial Truck Div. of Clark Equipment Co.

Chief advantages of the new design, according to the Clark bulletin, are faster operation, absorption of shocks detrimental to the uprights and to the entire truck mechanism, and elimination of need for a costly cover



The shovel is designed to handle small stampings, scrap steel, small castings, sand, gravel, stoker coal, grain, ashes, fertilizer, salt, wet mixed concrete and other similar materials which will fall through a $2^1/_2$-inch screen. It is easy to install and detach, and is interchangeable with standard forks and other attachments. Self-sealing hose couplers are part of the standard equipment. The device is pivoted on two cantilevers that extend from a fixed steel plate secured to a truck's fork bars by fork guides at the top, and clamps at the bottom.

A hydraulic cylinder, controlled by an auxiliary valve, tilts the shovel from a carrying position 30 degrees above horizontal to a dumping position 45 degrees below with uprights vertical. A chromium-plated piston rod is used, and the honed and highly-pol-

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ished cylinder walls are protected from abrasive materials by a wiper in the cap.

A full load of material may be carried with safety in the new shovel when it is tilted back. It can dump the load from any height without shock to the upright assembly.

The shovel is simple in design but ruggedly constructed of $^1/_4$-inch steel-plate with a $^1/_2$-inch-steel center-reinforcing plate running from top to bottom. The leading edge is a five-inch-wide blade of specially-hardened steel welded in place.

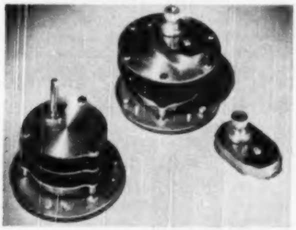
The shovel may be obtained in widths of 38 inches to 72 inches; capacities range from 8 cubic feet to 15 cubic feet. It can be installed on Clark gas-powered and electric battery-powered fork-lift trucks with standard rated capacities of 2,000 pounds to 7,000 pounds.

This device is available for Export sale.

Further information is available from the Clark Equipment Co., Industrial Truck Div., Battle Creek, Mich.

New Mechanical Drives for Meters, Controllers and Recorders Feature Detachable Escapements and Space Saving

Two new "midget" mechanical drives for instruments, meters, and other apparatus requiring timing—and characterized by a "capsulized" escapement mechanism which can be detached for service or replacement—are announced by the Pittsburgh Equitable Meter Div. of Rockwell Manufacturing Co., sales agents for the Macnick Division of the same firm. Overall diameters are only $3^1/_4$ in. and $3^3/_{16}$ in. respectively. Both models require only $1^{21}/_{32}$ in. between the plane of the driven chart (the rotation of circular dials and recorder charts being the most common use for such mechanisms) and the mounting ring.



The larger model (#24-3) has an 8-day wind and a basic 24-hour rotation. Patented "turrets," which merely snap on the main arbor, are available to convert the 24-hour rotation to 2-hour, 3-hour, 4-hour, 6-hour, 8-hour, 12-hour, 48-hour, 3-day, 7-day and 8-day rotation. This feature permits instrument users and manufacturers to reduce inventory by stocking only one basic drive mechanism, irrespective of the variety of rotation speeds involved.

The smaller model (#24-1) has a 24-hour wind with a torque which drops only from 8.6 to 4.7 inch-pounds between full-wind and 24-hour rundown. Thus enough extra capacity is designed into the unit to carry over a reasonable period of neglect and still give 1.8 inch-pounds of torque at 48-hour rundown.

Both models wind through the hub, the point of easiest access, and the same point at which charts are replaced in service.

A detachable "capsulized" escapement (sealed in clear plastic so as to be both visible and protected against dust and corrosive gases) is a feature on both models.

The design materially reduces maintenace cost and inventory requirements, and in-

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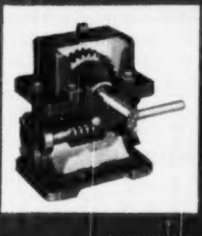

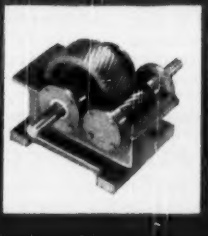

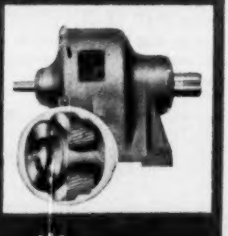

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creases accessibility. The escapement subassembly merely twists and snaps into place (no tools required) and controls mainspring action through a simple connecting square.

Escapements may be bought separately to control the timing of other devices. The standard escapement permits one turn of the connecting square per hour. Special escapements with rates of turn of only 2 minutes and 4 minutes are available for speeding up chart drives so that an indicated half-hour or quarter-hour is traversed in only one minute.

Both models mount (by snap action only) on a simple circular plate of $3^1/_4$ in. diameter, which in turn may be mounted on bosses in the instrument case, or on adaptors to fit any circumstance.

Main arbors fit standard chart hubs, and are directly tied to the mainspring. Drive cases are die-cast aluminum and sealed; escapement cases are stainless steel and clear plastic. Gears are mounted in phosphor-bronze bearings. Direction of rotation is optional, counter clockwise being furnished unless otherwise specified. Drive is self-starting.

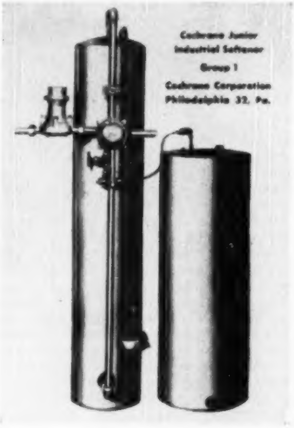
The combinations of (1) small size, (2) versatility of application, and (3) precision construction attained in the new Rockwell Midget Chart Drives is unusual and should be important to instrument designers and users requiring quality timing, reliability and easy maintenance, in restricted spaces.

Prices are $10.00 and $11.00 for the #24-1 and #24-3 respectively. Turrets for speed changing are $3.50 each.

For further particulars or literature address: Pittsburgh Equitable Meter Div. Rockwell Manufacturing Co., Pittsburgh 8. Pa.

A Small Industrial Zeolite Water Softener

A small zeolite water softener for apartment houses, hospitals, laundries, small boiler and industrial plants where the requirements may be under 100 gallons per minute is announced by Cochrane Corp., 3142 North 17th St., Philadelphia, Pa.



Designed for low initial cost, simplicity of operation and for low cost of chemicals used, the Cochrane Junior Industrial Zeolite Softener is supplied in two groups and in single and double units, to meet practically all requirements. Group I comes in 12", 18", 24" and 30" tank diameter, and Group II in 36", 42" and 48" tank diameter.

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The single unit is recommended if a storage tank for softened water is available which can be called upon while the softener is being backwashed and regenerated (about 45 minutes). A single unit may also be used if the supply of softened water can be interrupted during backwash and regeneration, or if raw water may be used temporarily during this period.

If this is not possible and a continuous supply of softened water is mandatory, the double unit softener is recommended.

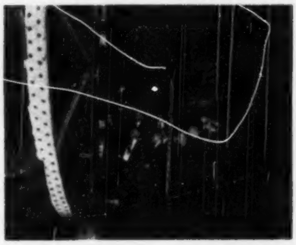
Various types of zeolite—high and low exchange green sand, synthetic gel, and resinous—are offered, making the softener readily adaptable to different water supplies and periods between regeneration.

The single control valve on the Cochrane Junior Industrial Zeolite Softener greatly simplifies operation, requiring little, if any, technical knowledge of the mechanism of the water softening process on the part of the operator.

Major Hydraulic Turbine and Generating Equipment

Major hydraulic turbine and generating equipment in process of manufacture at Allis-Chalmers was inspected on May 6 by the staff of Erik Floor & Associates, Inc., Chicago.

Shown viewing the interior of one of three Bull Shoals hydraulic turbines, each rated 62,000 horsepower at a speed of $128^1/_3$ rpm under 190-ft head, are (left to right) G. Ellis, H. Libner, A. Weiner, J. L. Schnitz, vice-president of Erik Floor & Associates, N. Mandel, W. J. Rheingans and Emil Gross of Allis-Chalmers hydraulic department; P. Fuchs, R. M. Cape, C. Maitre, L. Mosier and R. Palmer.



Shown inspecting one of three shop assemblies of six 2,000-horsepower Bull Shoals hydraulic turbines are (top row) Paul Hess, hydraulic department, Allis-Chalmers, and N. B. Jones; (lower row) A. R. Klann, hydraulic department, Allis-Chalmers; J. L. Schnitz, vice-president, Erik Floor & Associates, G. Ellis, W. E. McBride, N. Wolff, and W. J. Rheingans, assistant manager, hydraulic department, Allis-Chalmers.

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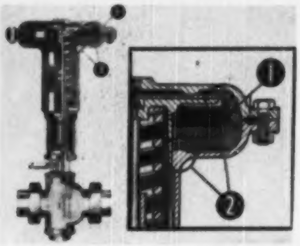
Erik Floor & Associates, Inc. has been working with the U.S. Army Corps of Engineers on such power projects as St. Marys Falls plant at Sault Ste. Marie, the Fort Randall Plant in South Dakota, and others.

Powers Flowrite Valve

Powers Regulator Co., 2751A Greenview Ave., Chicago 14, Ill., announce their new "Flowrite" Valve, a new air or water operated control valve for regulating flow of steam, water, oil or gases. Diaphragm operated for pressures below 250 psi; sizes $^1/_4$" through 8".



Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

Ball bearing non-rising type. Easily accessible, 180° turning radius with starting pressure adjustable from 0 to 17 psi. Has enclosed rust proofed steel spring for full travel in 5 or 10 psi control pressure change.

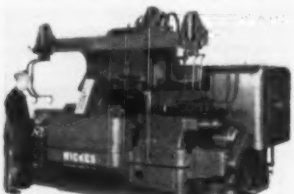
Polished stainless steel steam in preformed lubricated metallic packing insures long life and low hysteresis.

Special cast iron housing and top, only four bolts.

Single or double seat, double unions and flanged ends, direct and reverse acting and 3-way valves. Trim—stainless steel and bronze. All have rugged construction to withstand piping strains.

Center Drive Crankshaft Lathe

Wickes Brothers, Div. of Wickes Corp., Saginaw, Mich. announce the Wickes Model CF-4 Automatic Rough and Finish Turning Center Drive Crankshaft Lathe as illustrated.



Designed for rough and finish turning all crankshaft main line bearings and ends simultaneously, this machine incorporates three sets of cross slides which surround the crankshaft with cutting tools. Front and rear cross slides carry the rough turning tools and divide the tool load on the crankshaft during the cheeking, rough turning and filleting operation. A third massive slide which extends from spindle to spindle approaches the crankshaft from the top with finishing tools following a few thousandths behind the rough turning tools. When the roughing tools have reached their diameter, they slowly withdraw while the finishing tools continue their spacing operation and then proceed to finish turn and fillet the bearings.

The Wickes Model CF-4 Crankshaft Lathe is furnished with a hydraulically operated tailstock, live centers and an electric power operated chuck controlled entirely by a push button on the control panel. The operator needs only to load the crankshaft and press a button on the control panel to start the machine in automatic cycle.

Production, of course, depends on the type of crankshaft and stock to be removed. On one leading automotive crankshaft, the production obtained, from two of the older style crankshaft lathes with one operator, was 24 crankshafts per hour for rough turning only. Production of the same crankshaft, on two new Wickes Model CF-4 Lathes with one operator, is 35 crankshafts per hour for rough turning and also finish turning.

York Corporation's New Model FlakIce Machine Makes De-Aerated Ice Ribbons

York Corp., manufacturer of FlakIce machines, has added to its new 1950 model a plus feature which de-aerates its ice ribbons, according to John R. Hertzler, Vice-President and General Sales Manager.

The "de-aerated ice" feature was designed primarily to help keep the "zip" in carbonated beverages, although its translucent appearance makes it ideal for iced vegetable, salad, desserts, and similar displays in stores and restaurants. Hertzler claims that air, which is found in ordinary ice, tends to flatten carbonated beverages and gives ice a whitish cast.

It was pointed out that the new model, known as the York DER-11 FlakIce machine, will contain all the features of the DER-10, which has the same capacity tonnage, a ton a day. It is designed to produce the same curved shape ice ribbons for better contact chilling of refrigerated foods. Untouched by human hands during their manufacture, the ribbons are as pure as the water from which they are made.

The curved form of the ice prevents the ribbons from clumping together and because

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of their greater exposed surface area, this ice provides faster cooling of liquids. The ribbons are so delicate that they won't bruise or puncture any product they refrigerate. Meltage is retarded because of the shingling action of the overlapping curved FlakIce ribbons.

According to Hertzler, York has sold many thousands of these machines since they were first introduced more than ten years ago. Restaurants, hotels, food stores, dairies, hospitals, shippers, florists, poultry and sea food dealers have found that these machines have paid for themselves in less than a year depending a great deal on the type of application. Besides being convenient, FlakIce Machines manufacture ice at lower cost than it can usually be bought. Then, too, there are no labor costs involved to chip or crush the ice. Ice is made in a matter of seconds. "Just flip a switch", he said, "and there it comes—ice made at the point of use."

The model DER-11 is a completely self-contained machine producing up to 2,000 pounds of sparkling FlakIce ribbons a day, and is designed for economical use in any establishment requiring as little as 500 pounds or more of crushed, cracked, or shaved ice daily.

York also manufactures the Automatic Ice Makers which can produce daily 450 pounds of the popular crystal clear ice cubes-with-the-holes, and crushed ice. These are ideal for bars, restaurants, hotels, hospitals and other users of ice cubes and crushed ice.

The cabinet of the new model FlakIce Machine is made of bonderized steel finished in baked wrinkle taupe and glossy brown. Easily removable panels provide ready access to inside parts. Its compact design requires only 23 by 32 inches of floor space, and permits simplified installation.

The entire condensing unit is mounted on a spring carriage with flexible refrigerant and water connections to insure quieter operation. Safe, efficient Freon-22 refrigerant is metered by an automatic expansion valve. The unique design of shell and fin coil condenser provides low-cost, dependable operation.

The pure, sanitary ice is frozen on a polished stainless steel revolving drum. The outer shell of this drum is shrunk on a spiral machined passage which forms a highly efficient refrigerant evaporator.

The float admits fresh water to maintain a proper level in the sanitary stainless steel tank. A specially designed pump circulates the water from this tank to two headers which spray it on the freezing drum, resulting in sparkling ribbons of clear ice.

Stainless steel cutter blades turning freely above the freezing drum are rotated by the advancing layer of ice. The ice is loosened by these blades and flows out over the ice collecting blade and chute in distinctive ribbon form with so many desirable features. Built of stainless steel, the ice collecting blade and chute are rigidized for extra durability.

Dependable operation is assured by automatic protective devices—high and low pressure cutouts, built-in motor overload protection, mercury tube safety switch, and fusible plug in condenser. This machine has been approved by the Underwriters' Laboratories, Chicago.

Electro-Chemical Feed Control

When it is necessary to feed chemicals continuously and proportional to the flow of water entering a tank, you will find the New Permutit Electro-Chemical Feed Control well suited.

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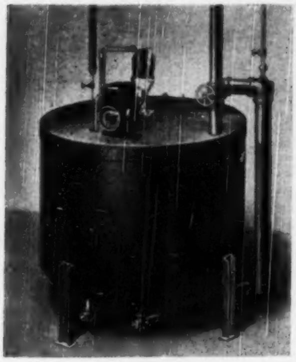
It is outstanding for its . . . (A) Accuracy of control, (B) Ruggedness which avoids failure due to frequent breakdown, (C) Flexibility permitting easy variation in the rate of feeding chemicals, (D) Absence of small measuring orifices that may be easily fouled by lime solution destroying accuracy of feeding, and (E) Prevention of chemical dust from escaping to atmosphere during time of charging chemical tanks.



Water flows through an integrating raw water meter. Integrator makes an electrical contact when a predetermined quantity of water has passed through the meter, thus starting the control unit and a time switch which limits the operating time of the control unit. The quantity of chemical solution is always proportional to the flow of water. The ratio of chemical solution fed can be varied by manually adjusting a knob on the dial of the time switch. The quantity of chemicals fed may also be varied by changing the density of solution in the chemical tank.

The dial gauge is part of the chemical control unit and is in the operator's view at all times. Where desired, a remote dial control can be purchased and mounted on a panel board. The second gauge will syncronize with the dial gauge on the control unit. For further information, write Permutit Co., 330 West 42nd St., New York 18, N. Y.

• BUSINESS CHANGES

Kirk & Blum Acquires Entire Plant and Property of Cincinnati Planer

The Kirk & Blum Manufacturing Co., Cincinnati, one of the nation's leading dust and fume control manufacturers, recently acquired the entire plant and property of The Cincinnati Planer Co. The plant, located at 3120 Forrer St. in suburban Oakley, will be occupied by Kirk & Blum about the end of the year.

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Eight acres of ground surround the facilities, which include over 100,000 square feet of one story manufacturing and storage space, all under one roof, fronted by a two-story, air conditioned office and engineering building. The plant is completely equipped with bridge and jib cranes and is served by its own railway spur and arterial highways. Ample supplies of power, light, heat, and compressed air are furnished by the Oakley Factory Colony, a cooperative power center.

The acquired acreage will allow considerable expansion when necessary. Kirk & Blum's five warehousing and manufacturing facilities, now scattered throughout Cincinnati, will be consolidated in the Oakley plant.

Kirk & Blum, founded in 1907 by Sylvester W. Kirk and Richard J. Blum, specializes in design, fabrication and installation of dust collecting systems, fume control systems and industrial drying and baking ovens. Other Kirk & Blum products include sheet metal parts and assemblies, weldments, electrical control boards and enclosures. The firm is also well known for its extensive work in stainless steel, aluminum and other special alloys.

B&W Tube Company To Build $1,000,000 Extrusion Plant

Beaver Falls, Pa.—A new $1,000,000 extrusion plant for the fabrication of tubes of ferrous metals and alloys in complex sectional shapes, will be built here, according to an announcement made by The Babcock & Wilcox Tube Co. The announcement followed the completion of a licensing agreement between the B&W Tube Co. and Comptoir Industrial d'Etirage & Profilage de Metaux of Paris, France, developers of the process and holders of the patent rights.

Isaac Harter, chairman of the board of the American company, explained that the new plant would be built at the site of the company's present facilities here. The process offers a method of fabricating alloys which are difficult or impossible to fabricate by the rolling or forging methods in use here today and makes it possible to produce hollow and solid sections of complicated shapes, he said. The key to the process is a new concept of lubrication of hot metal which solves the problem of lubrication and thermal insulation of the die and ingot holder. He explained that the extruding operation is carried out in a few seconds and at constant temperature, giving the extruded product uniform mechanical characteristics throughout its entire length.

Mr. Harter pointed out that in view of the fact that B&W Tube Company presently manufactures seamless and welded tubing, the new process will be used primarily in making carbon and alloy tubes of various sectional shapes.

The process is presently in commercial operation at the Persan, (France) plant of C.I.E., a subsidiary of Societé d'Electro-Chimie, d'Electro-Metallurgie et des Acieries Electriques d'Ugine, where it was developed during the war.

Peabody Engineering Corporation Opens Chicago Office

Peabody Engineering Corp. of New York, manufacturers of industrial burners, gas scrubbers, coolers and absorbers have appointed Allen H. Jones as Manager of their newly-opened Chicago office.

Although the Peabody Engineering Corp. maintain offices abroad, the Chicago office is the first Company-operated district office in the United States. The Chicago office was opened, according to Ernest H. Peabody,

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President and founder, to meet the need for faster and more direct handling of the firm's rapidly increasing field engineering assignments.

Consolidated Engineering Corporation's New Plant

June 21st marked the beginning of the Consolidated Engineering Corporation's new plant on the Hastings Ranch site. To celebrate the occasion, prominent civic and business leaders participated in a ground breaking ceremony.

Hugh F. Colvin (left) acting for the President, Mr. Philip S. Fogg, called upon Dr. Robert F. Bacher (right) to assist in the initial breaking of ground. Mayor Ray Benedict of Pasadena took part in the ceremonies and congratulated Consolidated Engineering Corporation on its present undertaking and hoped that the new plant would provide for the expansion of its efforts to make Pasadena known for its prominence in the research and development of technical instruments.

It was Dr. Bacher who sounded the key note on this occasion when he referred to the reputation Pasadena has gained as a leader in scientific research and knowledge. He felt that an important step was being made with the introduction of a new, light-industrial section in the city whose primary interest is employing the scientific knowledge long a part of Pasadena's tradition. The future of industry will depend upon rapid technical development and use of scientific knowledge. The strength of our armed forces will depend upon the cooperation and strength of industries and the complete utilization of scientific knowledge by the production and engineering resources of industry.

Boston Woven Hose Named for Penflex Products in Pittsburgh

The Pennsylvania Flexible Metallic Tubing Co., Philadelphia, has appointed as their distributor in the Pittsburgh area, the Boston Woven Hose & Rubber Co. of Pittsburgh, 123–125 Water Street, Pittsburgh, Pa.

The addition of the "Penflex" flexible metal hose enables Boston Woven Hose to round-out their line of quality hose products. This move will provide industry in the Pittsburgh area with the latest in flexible metallic hose developments and improved technical service through the facilities of a factory trained service man.

Penflex products include blower and ventilation hose, tar and asphalt hose, marine unloading hose, and hose for gasoline pumps, tank-wagon distillates and fuel oil. The "Penflex" "twin-lok" feature is the latest in metallic hose design and allows material to flow easily without any obstructing edges.

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It is ideal for the transmission of grain, dust, slag, insulation and other granual material.

"Penflex" recently published a new catalog which describes the features of "Twin-Lok." Copies may be obtained from Boston Woven Hose & Rubber Co. of Pittsburgh, or the Pennsylvania Flexible Metallic Tubing Co., Philadelphia 42, Pa.

Yarnall-Waring Appointments

Yarnall-Waring Co., Philadelphia manufacturers of steam plant equipment, announces the following appointments in the Yarway sales organization: Lytton C. Musselman in charge of Los Angeles district at company office in Huntington Park, California; Power Engineering Co. as general sales representative in Salt Lake City; Wallace J. Agren as sales engineer in Chicago branch, replacing F. C. Harry Vaughan, deceased; R. W. Westlake as sales engineer in Cleveland branch; Andrew M. Ritter, district manager of Detroit branch, replacing Charles H. Grosjean who is returning to the New York territory. Lyle G. Chase, Jr. has joined the sales engineering staff of the New York district office.

Key Connecticut Teachers To Attend "Technical Workshop"

A concentrated program of instruction in the latest techniques of designing and applying carbide tools has been presented to key instructors from Connecticut's trade and industrial schools at the Hartford Trade School, 110 Washington St., Hartford, Conn., during July 10, 11, 12 and 13 and again during July 24, 25, 26 and 27. The course—which is sponsored by the Connecticut State

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Department of Education Vocational Field Service—was directed by F. J. Stepeck, Assistant Director, Vocational Field Service, Connecticut State Department of Education. Instructors who will "teach the teachers" at this "Technical Workshop" were furnished by Carboloy Co., Inc., Detroit.

The four-day program of instruction was especially designed to help the vocational and trade instructors "brush up" on the fundamentals of carbide tool practice which they must in turn "hand on" to their classes. Carboloy Cooperative Carbide Training Materials—including discussion-type slide films, motion pictures, etc.—will be used throughout. This material was presented just as the trade and vocational teachers would themselves use it in their own classes—that is, by means of discussions and actual shop demonstrations.

Subjects in each of the two separate four-day sessions of the "Technical Workshop" include such vital subjects as the design, brazing, sharpening, and application of single point Carboloy tools. The important topic of "trouble shooting" was also covered, as was milling with carbides and the use of negative rake tools and tools for interrupted cuts.

Linear Extends Pacific Coast Representation

Linear, Inc., Philadelphia, Pa., manufacturers of hydraulic packings and precision molded rubber products, announce the extension of their Pacific Coast representation to the San Francisco area and northern California.

The Haskel Engineering & Supply Co., Linear's exclusive west coast representative, with main offices at Glendale, California, has opened a full service branch office at 1245 22nd Street, San Francisco.

The San Francisco office will be under the management of Mr. E. C. Osborn who has long engineering experience and a thorough knowledge of mechanical packings problems. Haskel Engineering & Supply Co. at San Francisco will have available complete stocks of specification or commercial "O" Rings as well as many other types of mechanical packings such as asbestos, flax, duck and rubber, semi-metallic, plastic and sheet.

M. W. Kellogg Announces Sale of the Kellex Corporation To Vitro Manufacturing

Warren L. Smith, president of The M. W. Kellogg Co., refinery and chemical engineers of Jersey City and New York, announced that the company had sold the stock and assets of one of its subsidiaries—The Kellex Corp.—to The Vitro Manufacturing Co.

"This step," said Mr. Smith, "is in accord with Kellogg's policy of concentrating its commercial development, engineering and manufacturing efforts in the petroleum, chemical and power fields and of confining its governmental contracts to development engineering and manufacturing in the fields of jet propulsion, guided missiles, etc." These latter activities are conducted by Kellogg's Special Projects Division in Jersey City.

Contracts currently held by Kellex, primarily in the field of atomic energy development, will be continued by that organization.

Newport News Firm Appoints New England Representative

The Newport News Shipbuilding & Dry Dock Co. of Newport News, Va., has announced the appointment of the Whitty Engineering Co. of 10 High St., Boston, as its New England sales representative. The Boston concern, headed by W. H. Whitty,

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will have the complete New England territory, including that of Connecticut east of the Housatanic River. They will represent the Newport News firm in the sale of all of the products of that company with the exception of shipbuilding.

The Newport News company, which has long been prominent in the water power equipment field, has diversified its output since the end of the war to include production of a great many other items of industrial equipment. Included in this output has been rayon machinery, wool cards, petro-chemical plant equipment, thermal plant equipment, paper and pulp mill equipment and many other items of special machinery.

New Departure's Eastern Territory Rearranged

On July 1st, the Washington, D.C. Office of the New Departure Division of General Motors was discontinued, it is announced by Frank J. Miller, General Sales Manager.

The territory previously covered by that office will henceforth be served by the Philadelphia Zone Office at 850 East Luzerne Street, Philadelphia 24; telephone, Garfield 3-4136, of which Harry A. Herold, Jr., is Manager.

• LATEST CATALOGS

Morse Factory-Packaged Roller Chains and Parts

The Morse Chain Co., Division of Borg-Warner Corp., in recently announcing a complete packaging program for roller chains and parts has produced a four-page catalog insert which gives complete details. All available standard packaged quantities are listed together with package weights and list prices. Write for bulletin F57-50, Morse Chain Co., 7601 Central Ave., Detroit 8, Michigan.

Data Sheet Available on New Portable Bagging Scale

The Richardson Scale Co., Clifton, N. J., has just made available a data sheet on their new Model E-50 Portable Automatic Bagging Scale for mash feed, pellets and similar materials.

The new Portable Scale is designed to serve a row of bins, and is completely dustproof. A flexible, dust-tight bin connection allows the heavy-duty scale to be positioned under a bin easily and quickly. The scale operator makes all necessary adjustments from the floor level, simply by pulling a chain.

Capacity of the E-50 Portable Automatic Scale is 1 to 4 cu. ft.; rate of discharge, from 10 to 15 per minute. The scale is gravity fed and all mechanisms are easily accessible. An agitator is included in the inlet chute to handle sluggish materials. Four single-flange roller bearing wheels at the base of the scale frame permit it to run along a track under supply bins.

The data sheet on this new Portable Automatic Bagging Scale includes a dimensional working drawing, detailed photographs, and complete mechanical and electrical specifications. Write to the Richardson Scale Co., Clifton, N. J., for product data sheet No. 4916.

Hauck Oil Burner

Hauck Manufacturing Co., 124–136 Tenth St., Brooklyn 15, N. Y. has issued a new Catalog No. 456 which is just off the press.

It describes the Hauck Venturi High Pressure Steam or Air Atomizing Oil Burner for industrial firing applications in smelting, metal heat treating, glass, ceramic, chemical, paving and rock product plants, oil refineries, etc.

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How the higher operating efficiency is obtained with the Venturi principle in atomizing oil is explained in the phantom photo, drawing and text on page 2.

The 3 flame types (cylindrical, conical and flat) enable the selecting of the burner best suited the job requirements.

New Boston Gear Catalog No. 55

Boston Gear Works announces that a new edition, No. 55, of the complete Boston Gear Catalog has just come off the presses.

Catalog No. 55 contains much information on new stock Boston Gear items together with application, selection and ready reference data that has not appeared in previous editions. It also includes all of the product and engineering information in quick reference form that has made the Boston Gear Catalog an almost indispensable part of the working kit of designers and users of power transmission equipment and component machine parts everywhere. It lists over 100 product groups, including spur, miter, bevel and worm gears, roller chain, sprockets, ratiomotors, ball bearings, couplings and pulleys—over 4,500 stock items. It provides engineering data, formulas, horsepower rating charts, reference labels and selection charts to enable anyone, even without technical training, to figure the correct power drive and select the right equipment for virtually every mechanical power transmission.

Important products appearing for the first time in the Boston Gear Catalog include "Bost-Bronz" Oil Impregnated, Porous Bronze Bearings cataloged in a wide range of stock sizes and with complete data on assembling, sizing, shaft clearances and loads; the new Boston Universal Joints made with interchangeable parts and cataloged for quick selection by size and rating; the new Boston Pillow Blocks and Flanged Cartridges equipped with the exclusive Safety-Vent-Seal for automatic lubrication control and cataloged for ready selection of the proper size and load rating; and new model Boston Reductors (Speed Reducers) complete with selection charts and improved numbering system for rapid, foolproof determination of the right model for the widest range of application.

This practical, time-saving Catalog and Data Book may be obtained from any one of the eighty Authorized Boston Gear Distributors who maintain stocks of the full Boston Gear line, or by writing Boston Gear Works, 66 Hayward St., Quincy 71, Mass.

Hydraulic Turbines and Auxiliaries

A new 56-page bulletin describing the design and construction of Francis, propeller and impulse type, hydraulic turbines and such auxiliaries as pressure regulators, special high head valves, butterfly valves and cabinet type governors for large units, has been released by Allis-Chalmers.

Installations of Francis type turbines in the United States covered in the bulletin include the Hoover Dam, Cushman, Shasta, Fontana, Peavy Falls, Big Quinnesec Falls, upper and lower Malad, Pensacola, Mitchell and Wilson plants; the Santa Barbara and Colimilla plants in Mexico, Shipshaw in Canada, and the Maraetai plant in New Zealand.

Propeller type installations described include the Kentucky Dam, Pickwick Landing, Rock Island, Santee Cooper, Fall of the Ohio, Way Dam, Henry Ford Green Island, and Blandin Paper Co. plants.

Impulse wheel type plants covered are the Serra powerhouse in Brazil, Honokaa Sugar Co., Hawaii; Cementos el Cairo, Colombia;

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• Keep Informed

and Glenville, Balch, San Francisquito, Big Creek 2A and Kern River plants in the United States.

The booklet also has a section devoted to manufacturing and testing facilities at Allis-Chalmers which illustrate the company's ability to produce hydraulic turbines of any practical magnitude.

Allis-Chalmers has played an important role since 1904 in the design and building of hundreds of hydraulic turbines, totaling approximately 12 millions of horsepower installed and under construction.

Copies of the bulletin, "Allis-Chalmers Hydraulic Turbines and Auxiliaries," 02B-7301, are available upon request from Allis-Chalmers Manufacturing Co., 949 S. 70th St., Milwaukee, Wis.

H-42 Strainalyzer

Aptly named, the H-42 "Strainalyzer" is a new instrument for the study and analysis of vibration strain and dynamic stresses. It makes possible for the first time the simultaneous observation and recording of electronic traces of four such functions in correct time relationship without the necessity of optical alignment.

Designed for use with Baldwin SR-4 Strain Gages, from 60 to 500 ohms, the instrument gives excellent linear response. It is composed of four units; the indicator, the indicator power supply, the camera and the camera speed control.

The cathode ray tube is a four-gun type designed especially for the "Strainalyzer." In designing the indicator cabinet and in placing the tube, special provision has been made to facilitate installation and removal of the Fairchild Oscillo-Record Camera.

Copy of our Bulletin 309 covering this equipment is available. You will be interested in the variety of general uses to which the "Strainalyzer" is readily adaptable. It also offers substantial savings in time and money over methods now in use, which generally require an array of instruments and varying test procedures.

Armco Stainless Steel "Steelox" Curtain Walls

Armco Stainless "Steelox"—what it offers and how it is used in curtain walls—is described in a new illustrated 12-page booklet Armco Stainless "Steelox" Curtain Walls, published by Armco Drainage & Metal Products, Inc., Middletown, Ohio.

Explaining the basic functional design of the "Steelox" curtain wall, the booklet lists 13 architectural advantages of "Steelox" panel construction.

Eight pages of design sketches show how "Steelox" can be used as either vertical or horizontal units and to provide varied exterior treatments. The sketches also show details of sections at masonry walls, wall bases, windows, as well as plan views of spandrel and strut construction.

Architects will find this booklet a handy reference manual in view of the tremendous interest in curtain wall construction. Copies may be obtained from Armco Drainage & Metal Products, Inc., Middletown, Ohio.

Combination Units Featured in Montreal Refinery Modernization

The design and engineering of two unique combination units in modernizing the Montreal refinery of the British American Oil Co., Ltd., are featured in "Kellogram" No. 3 (1950), just published by The M. W. Kellogg Co., refinery and chemical engineers of Jersey City, N. J.

Not only does the publication cover the combination deasphalting and crude topping

and the combination Fluid catalytic cracking and catalytic polymerization units in detail, but it also shows how, through painstaking process design, heating requirements were balanced so that important savings were effected in furnaces and intermediate storage.

The modernization comprised integrating these two new combinations with the existing 16,000-barrel-per-day thermal refinery. As a result the plant's capacity was upped almost 100 per cent, and the over-all octane level of the refinery's gasoline was raised to meet the increased demand for higher octane products.

In engineering the new plant to meet foreseeable demand for even higher octane levels than are now necessary, provision was made for two more polymerization reactors to be added if future market conditions so dictate. The use of synthetic catalyst and more severe operating conditions in the catalytic cracking unit could readily produce the additional gaseous charge stocks for the polymerization unit without any mechanical alterations.

Chain Couplings

Morse Chain Co.—New Catalog, C45-49 contains 16-pages of information and engineering data on the new Morse line of roller and silent chain flexible couplings. The new DRC and DSC couplings are interchangeable and may be furnished with either plastic or steel covers. Made-to-order Silent Chain Couplings are furnished in capacities ranging up to 300 H.P. per 100 R.P.M.

"Adsco" Strainers and Separators

"Strainers and Separators," Bulletin No. R-46-50A, is a completely revised 16-page catalog of Y- and T-Type Strainers, Suction Strainers, Multi-Flow Separators and Receiver-Separators just issued by American District Steam Co., North Tonawanda, N. Y. It contains descriptions, dimensions, weights and list prices of the entire line. Several types have been completely redesigned for increased efficiency and the range of sizes has been increased. Included in the Bulletin is technical data to aid in selecting proper type and capacity. Engineering information on flange dimensions and service pressure ratings is also a part of the revised edition.

Fundamentals of AC Circuit Interruption

A concise presentation of circuit closing and opening operations by Dr. Erwin Salzer, consulting engineer, Allis-Chalmers Manufacturing Co., presented in easy-to-grasp form. This booklet, in substance a reprint of a series of Articles on "Fundamentals of AC Circuit Interruption" published in the Allis-Chalmers Electrical Review of 1948 and 1949, is written on the level of a college text on physics. It emphasizes physics and physical reasoning. Size $8^1/_2$ by 11 inches; 56 pages; paper bound. Published by Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis. Price 40 cents.

Nooters Corporation Offers New Flange and Coupling Selector

A handy new Flange and Coupling Selector, designed by Nooter Corp. of St. Louis, is now available upon request to all engineering personnel.

This selector is an exceptionally useful tool for engineers and draftsmen who must work with pipe and pipe connections. The handy slide rule presents at once all pertinent data for 150 pound and 300 pound A.S.A. Standard as well as for standard, extra heavy, 3000 pound and 6000 pound coupling.

An easily read table also shows wall thicknesses of Standard, Extra Heavy and Double Extra Heavy Pipe as well as for all Schedules of Pipe from 10 through 160. Write Nooter Corp., 1444 S. Second St., St. Louis 4, Mo.

Sarcotherm Modulating Outdoor Controls

Sarcotherm Controls, Inc., Empire State Building, New York, N. Y., have just issued a Supplementary Bulletin, ST-501, to their General Catalog. This supplement describes in detail the recent improvements in the Sarcotherm Modulating Outdoor Controls. Additions include convenient manual adjustment features, "full heat" switch, morning pickup and night setback—all mounted in a panel box. A revised chart for enlarged capacity, double seated valves is also enclosed. Copies of the Supplementary Bulletin are available to interested architects, consulting engineers and heating contractors.

Master Price Schedules for Seamless Carbon Steel Pressure Piping

Beaver Falls, Pa.—Individuals involved in the purchase of tubing or the estimation of cost apparatus in which seamless carbon steel pressure tubing is used, will be interested in master price sheets recently issued by The Babcock & Wilcox Tube Co.

These master price sheets, identified as price schedule "A," give the base prices per 100 feet of average and minimum wall hot finished and cold drawn seamless carbon steel pressure tubing. The schedule covers cut

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length tubing produced from open hearth steel having an average carbon content within .10% to .25% and having outside diameters $^1/_2$" through $10^3/_4$" and wall thicknesses .035" through 1.000".

These helpful tables were prepared as a convenience to customers and jobbers. Copies are available upon request to the sales offices of the company at Beaver Falls, Pa.

Terry Issues New Turbine Booklet

A new 12-page booklet (Bulletin S-146) titled "The Terry Multistage Turbine" was recently announced by Terry Steam Turbine Co., Hartford, Conn. Requests for copies should be sent to Dept. P.

Illustrated with photos and drawings, the bulletin gives data on casing, lagging, blades, nozzles, wheels, shafts, diaframs, bearings, interstage and end glands, governors, synchronizers, governor valves, steam strainers, nozzle control valves, sliding feet, auxiliary oil pumps and lubrication.

Two New Technical Bulletins Issued on Engineering Properties of Nickel Alloys

Two new technical bulletins on the properties of high nickel alloys have been issued by The International Nickel Co., Inc. Both are twenty-four pages in length and contain charts, tables on compositions and properties, working instructions, and other information of a technical nature.

While each of the bulletins represents, to some extent, revisions of earlier bulletins on the same subjects, the revisions have been so complete and the new data contained so extensive that they are essentially new presentations.

Technical Bulletin T-7, one of the two, is entitled, "Engineering Properties of Inconel." In addition to information on Inconel, it contains material on Inconel "X", one of the newer age-hardenable Inco nickel alloys.

The second publication is Technical Bulletin T-9 and deals with the engineering properties of "K" Monel and "KR" Monel. Both are available without charge through the Technical Editor of The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y.

Farrel-Birmingham Publishes Calender Bulletin

A new bulletin, No. 117, "Farrel Paper-Machine and Board Calenders," has been released by Farrel-Birmingham Co., Inc., Ansonia, Conn.

Available upon request to those interested in paper-making equipment, this 12-page booklet illustrates paper-machine and board calenders in a wide range of sizes, including the largest machine for calendering paperboard which has yet been built.

Concise descriptions are given of design features, and the bulletin also contains illustrations of typical calender installations and a resumé of other machine products made by the company for the paper industry.

New Bulletin Lists Range of Standard Tracers for Measuring Surface Roughness

An illustrated bulletin on the complete line of Profilometer equipment is announced by Physicists Research Co.

Entitled "Whatever Your Needs in Roughness Measurement," this new publication lists the range of work—internal and external—covered by each of the standard Profilometer Tracers. These items are grouped under three headings: Equipment (1) for straight-line tracing on normally-accessible surfaces; (2) for straight-line tracing at right-angles to axis of vertical holes; and (3) for circular tracing. The equipment listed measures the roughness of 99% of all surfaces produced by machining, grinding and finishing operations.

The bulletin also lists appropriate piloting for each Tracer (manual, mechanical, or both), and describes standard piloting equipment. Illustrations show typical shop applications.

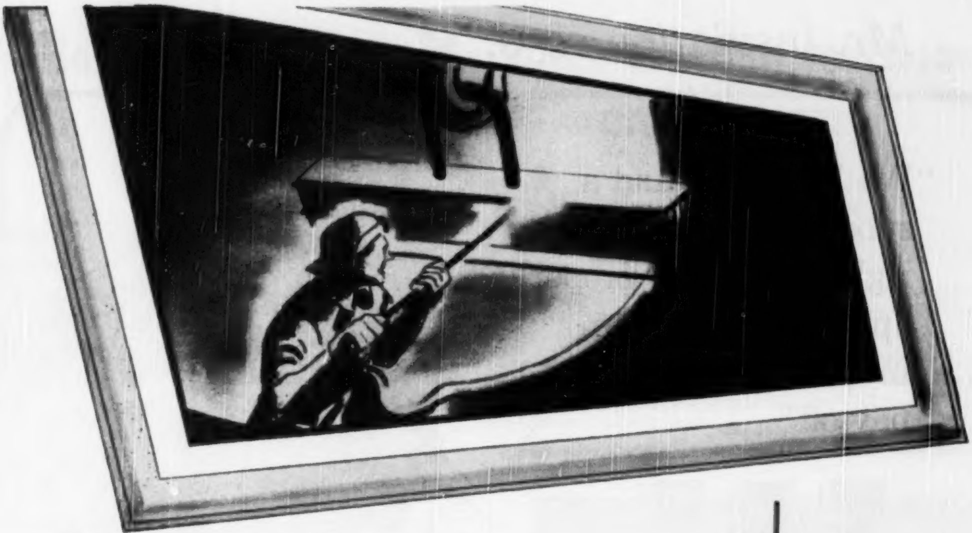
Copies of this bulletin are available on request from Physicists Research Co., 321 S. Main St., Ann Arbor, Mich.

New Air Trap Bulletin

Armstrong Machine Works, Three Rivers, Michigan, has recently issued a new 4-page bulletin describing their complete line of air traps. Selection and installation of air traps for automatic drainage of moisture from compressed air intercoolers, aftercoolers, receivers, separators and drip points, is covered in some detail. Illustrations of the various Armstrong air trap models, their applications and how they work are covered in other sections. Physical data and list prices are also included. Copies are available upon request.

Over-Running Clutches

Morse Chain Co.—The new Morse-Formsprag Over-running Clutches are fully described in a 16-page Catalog, C11-48. Construction, function, engineering data, standard and special applications are discussed in detail.



LUNKENHEIMER

. . . The Steel Valve With A Priceless Ingredient

Into every heat of Lunkenheimer molten steel goes one ingredient that no other valve foundry can duplicate. It's not measured in ounces or pounds — but in generations . . . of tradition. It is pride in the kind of workmanship that has made Lunkenheimer universally respected as the one *great* name in valves.

Engineers are accustomed to dealing in facts — not intangibles. But every realistic engineer knows that molten steel is tricky stuff to handle. It demands *more* from the workman than simple attention. Quality valves—safe valves—are not made by formula alone, but by care . . . interest . . . pride in an unbroken tradition of fine workmanship. At Lunkenheimer, that tradition goes back to 1862.

Lunkenheimer's priceless ingredient will always be intangible, but it can be expressed in terms of one interesting fact: *there is no instance on record where a Lunkenheimer steel valve has ruptured due to defective metal.* For more facts — and for information relating to your specific steel valve application — write immediately to The Lunkenheimer Co., P. O. Box No. 360E, Annex Delivery Station, Cincinnati 14, Ohio.

STEEL · IRON · BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

How to cut costs when drafting revisions are necessary

* **A case history based on the experience of the Virginia Department of Highways**

1

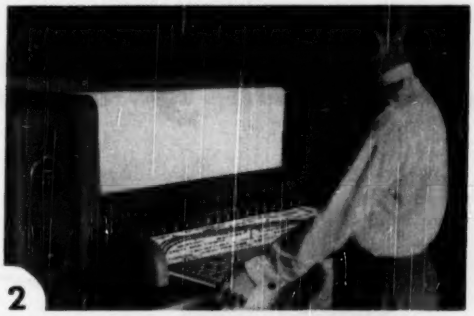
Long-lasting intermediates are assured. In a "permanence test" made by the Virginia Dept. of Highways, an Autopositive print was left on a roof top for 36 days. During this time this photographic intermediate was exposed to 200 hours of sunlight . . . 6.88 inches of rain. Despite all of this abuse it was declared "good as new."

Proof, indeed, that "Autopositives" will stand up under less trying, normal conditions . . . will remain intact in the files year after year . . . ready to produce sharp, clean blueprints whenever needed.

TODAY the State of Virginia is engaged in a long-range Highway Zoning Program which necessitates changing thousands of drawings to include proposed right of ways.

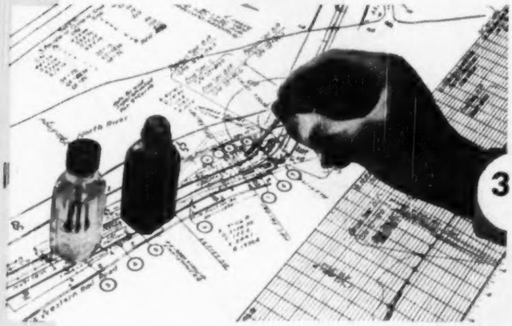
How to do the job most economically was an important question: Retracing was ruled out—too slow, too expensive. The use of intermediate prints was considered next. They had to be long-lasting . . . easy to make . . . easy to revise.

Here's why Kodagraph Autopositive Paper was chosen for the job:



2

Photographic intermediates are produced at a new low cost. When "Autopositive" is used, positive photographic intermediates are produced *directly* without a negative step, without darkroom handling. Maximum efficiency is realized by the Virginia Dept. of Highways because its "Autopositives" are turned out automatically . . . in a continuous blueprint machine, which can be converted readily for Autopositive production.



3

Drafting revisions are easily made. Unwanted details—such as existing right of ways—are removed quickly from "Autopositives" with corrector fluid. Then the proposed right of ways are drawn in with pencil or ink. Thus, new masters—prepared without costly redrafting—are ready to turn out the blueprints needed for county supervisors and resident engineers.

Kodagraph Autopositive Paper

"The Big New Plus" in engineering drawing reproduction

MAIL COUPON FOR FREE BOOKLET

16

- **It enables you, or your local blueprinter, to produce positive photographic intermediates at a new low cost.**
- **It enables you to protect valuable originals from wear and tear . . . obtain more legible final prints.**
- **It gives you photo-lasting file copies.**
- **It restores old, worn drawings . . . reproduces opaques.**

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Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a copy of your illustrated booklet giving all the facts on Kodagraph Autopositive Paper.

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Kodak
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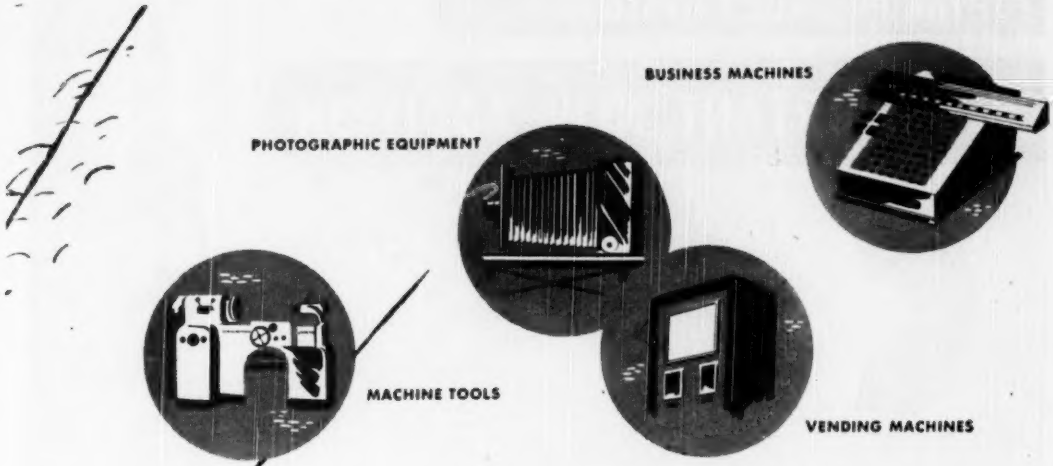
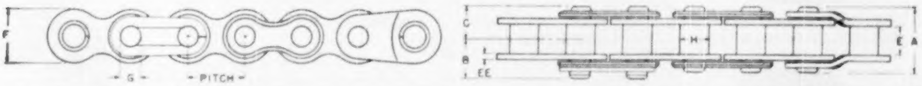


for machine designers!

Machine designers! Here's the newest addition to the complete Baldwin-Rex line of precision-made roller chains. It is the answer to that problem of transmitting positive power where space is limited, where centers are extremely short, where savings in weight and a combination of high strength and accurate timing are required . . . Baldwin-Rex No. 25 Roller Chain. This ¼-inch pitch chain is as finely made . . . as long lasting . . . as versatile and positive as the larger size roller chains. And despite its small size, it has an ultimate strength of 875 pounds . . . an important advantage where reduced maintenance and service are needed.

Hand power tools, juke boxes, animated displays, machine tools, photographic equipment, electronic equipment, television equipment, business machines, model equipment and many other types of high precision, small size equipment can be more efficiently designed with this new helping hand to the designer. In many larger types of equipment, too, this handy little chain can motivate intricate timing functions that must be designed into small space.

For all the facts, write Baldwin-Duckworth Division of Chain Belt Company, 363 Plainfield Street, Springfield 2, Massachusetts.



Principal Dimens.			LIST PRICES				DIMENSIONS — INCHES								
Pitch	Roller Width E	Roller Diam. H	Riveted Chain Per foot	Connecting Link Each	Assembled Roller Link Each	Offset Link Each	Over-all Riveted A	From Pin End to C.L. B	From Pin Head to C.L. C	Side Plate Thickness EE	Side Plate Height F	Pin Diam. G	Average Ultimate Strength Lbs.	Average Weight per Foot Lbs.
¼	⅛	0.130	$1.10	$.14	$.10	$.40	0.31	0.19	0.15	0.030	0.23	.0905	875	.085

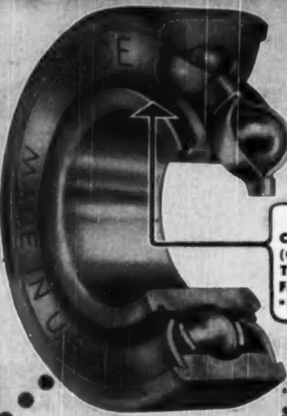
BALDWIN·REX ROLLER CHAINS

a complete line from ¼-inch to 2½-inch pitch

BALDWIN-DUCKWORTH DIVISION OF CHAIN BELT COMPANY

for the PRODUCT DESIGNER . . .

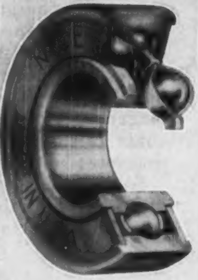
an IMPORTANT NEW ADDITION



NEW!
COMPOSITION SEAL*
(OIL RESISTANT SYNTHETIC RUBBER COATED FABRIC)
*PATENT APPLIED FOR

"1600" and "3000" Series Composition Sealed

to the NICE LINE



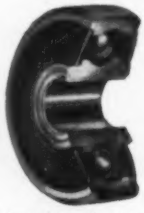
"1600" and "3000" Series Shielded or Open

Available as Illustrated, Series "1600" Low Cost Precision Radial Bearings and Series "3000" Unground "Precision Type" Radials, Metal Shielded or Open, or with COMPOSITION SEALS. Solid Race and Cone with Retainer, Inch Sizes.

"100" Series Ground Deep Groove Radial, Full Ball Type, Soft Outer Band, Inch Sizes.

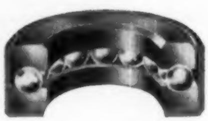
"400" Series Unground Deep Groove Radial, Full Ball Type, Soft Outer Band, Inch Sizes.

"1200" Series, Similar to "400" Series Except Double Row.



"K" Series (Aircraft and Commercial) Precision Deep Groove Radial, Full Ball Type, Double Shielded, Inch Sizes.

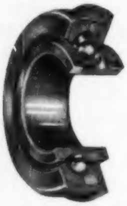
Ground Thrusts, Series "1000" "1100", "2600" and "2700", with Retainer, Inch and Metric Sizes.



"600" Series Self Contained Unground Thrust, Full Ball Type, Soft Outer Band, Inch Sizes.

"500" Series Unground Radial and Thrust, Full Ball Type, Pressed Cone, Soft Outer Band, Inch Sizes.

"700" Series Unground Radial and Thrust, Full Ball Type, Solid Cone, Soft Outer Band, Inch Sizes.



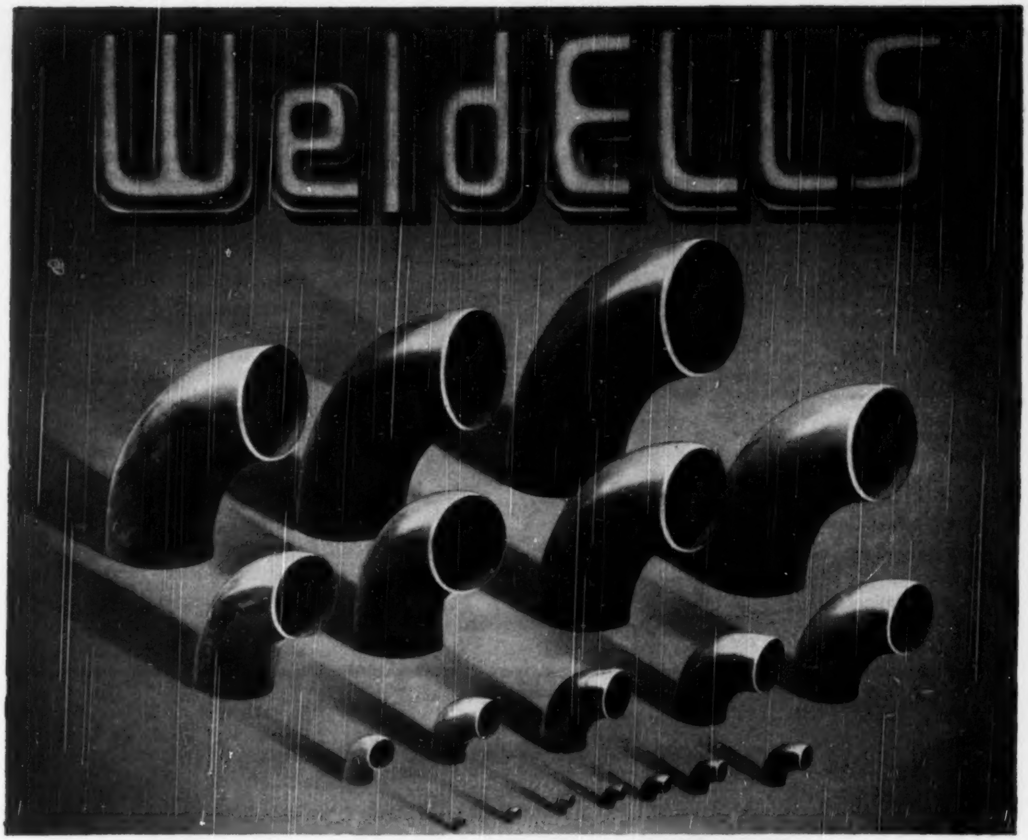
"Flanged" Series, Similar to "400" Series Except Outer Band Flanged.

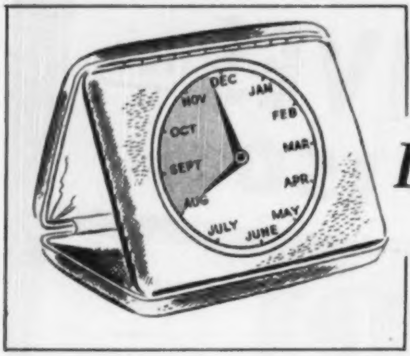
"Flanged" Series, Similar to "400" Series Except Felt Sealed and Outer Band Flanged.

For complete information on the NICE Line write for New Catalog No. 140

NICE

NICE BALL BEARING COMPANY
NICETOWN PHILADELPHIA PENNSYLVANIA


WeldELLS



It's later than you think!

19th NATIONAL POWER SHOW

NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

GRAND CENTRAL PALACE, N.Y.

NOV. 27 to DEC. 2

RUSH

your reservation for

SHOWING . . .
TELLING . . .
SELLING . . .

your best buyers at the . . .

Yes, it's August already . . . and just three short months from now thousands of your prime customers and prospects will be converging on the 1950 National Power Show. They'll be eagerly seeking for new ways to keep down the costs of producing and using steam, electric, and mechanical power.

You can make no better investment in selective, concentrated selling to the "right" people than to show, tell, and sell the cost-saving merits of your products in this important industrial "market-place." This outstanding show offers you proved sales benefits . . . enables you to see and talk with far more keenly interested potential buyers than you could possibly contact in the same time otherwise . . . to save months of field sales work later on . . . to effectively strengthen the position of your company and products in today's increasingly competitive market.

The Power Show has consistently produced excellent results for many firms for 28 years. So make it a "must" today to insure better sales and profits tomorrow.

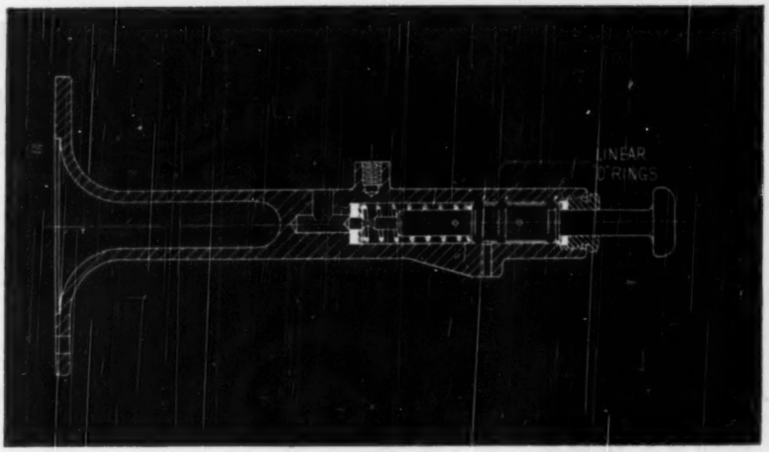
APPLY FOR SPACE TODAY

Time is short. Act now while a few exceptionally good spaces are still available. Write for space diagram, rates and data.

UNDER ASME AUSPICES

in conjunction with the Annual Meeting of the Society in New York City, Nov. 26–Dec. 1.

Management International Exposition Company, Grand Central Palace, New York 17, N. Y.



TIP...

FOR THE DESIGNER

Compensate For Variable Friction Loads With...

LINEAR PRECISION MOULDED "O" RINGS

The precision with which LINEAR "O" RINGS are moulded to specifications . . . coupled with their high level of uniformity . . . makes them a natural for products with delicate assembly problems.

West Disinfecting Company had an unusual assembly problem in connection with the feeding mechanism of an individual type soap dispenser. It required a seal with enough flexibility to compensate for variable friction loads . . . but free enough to permit easy axial movement of the plunger for uniform delivery of soap.

LINEAR "O" RING SEALS met the requirements . . . leakproof yet non-restricting. Requiring no replacement, they are permanent . . . assuring satisfactory service for the soap dispenser and economically eliminating a troublesome assembly problem.

Compounded of natural or synthetic rubber for nearly every condition, LINEAR "O" RINGS are also available in Kel-F, Silicone and other synthetics to resist the action of vigorous oxidizing materials. LINEAR has a complete list of J.I.C. and A.N. standard sizes, as well as hundreds of non-standard "O" Rings for special uses.

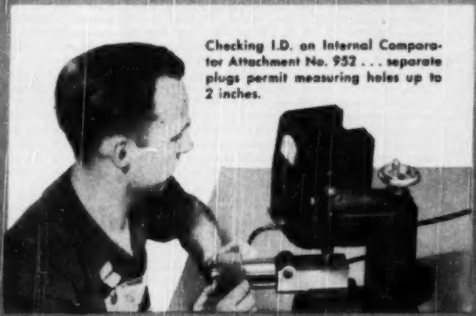
For individualized attention to your packing problem, design or application, CALL LINEAR!

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK STREET, PHILADELPHIA 35, PA.

This versatile electronic measuring equipment PAYS ITS WAY IN MANY WAYS



Checking I.D. on Internal Comparator Attachment No. 952 . . . separate plugs permit measuring holes up to 2 inches.

Checking O.D. with External Comparator No. 951, and Amplifier No. 950 mounted on Signal Light Attachment No. 958.

Checking an inside micrometer to a high degree of accuracy with Gage Head Cartridge No. 953 in fixture

Checking gage size with Gage Head Cartridge. Complete freedom from differences in "touch" of different operators.

With this equipment, you can gage a variety of small precision parts on a mass production scale so fast and so accurately that costs drop. No special skill needed. Savings over slower, more tedious methods quickly pay for this equipment.

When used as a part of a Quality Control Program, this Brown & Sharpe Electronic Equipment offers even greater savings. It permits closer, faster coordination of inspection with production . . . making possible a substantial reduction in rejects, wasted time and effort.

This modern gaging equipment is designed and constructed with characteristic Brown & Sharpe precision. For complete information on its unique features, write Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

UNIQUE FEATURES

- Separate amplifier isolates heat-producing elements.
- True linear response permits accurate setting for entire scale with only 1 master block.
- Single amplifier may be used to serve several testing instruments.
- Normal line voltage fluctuations do not affect readings.
- Simple turn of graduation selector provides accurate readings in any desired increment from .0001" to .00001".
- Simple, self-checking device on external comparator . . . no gage blocks needed.

We urge buying through the Distributor

BROWN & SHARPE BS

New and Revised American Standards

INVOLUTE SERRATIONS B5.26—1950 $1.00

The Standard not only replaced the SAE Serrated Shaft Standard, but provides a uniform, easily fabricated set of serrations that can be made by several manufacturing processes. Even diametral pitches have been adopted which are slightly coarser than the old SAE standard; the range of teeth used presents diameters both smaller and larger than the former standard so that throughout there is a much greater selection of sizes; the scope of sizes given has been increased for 40/80, 48/96, 64/128, 80/160 and the range of 32/64 moved downward to agree with the coarser pitches.

The introduction of allowable errors and effective fits into the Involute Spline Standard has made necessary the same procedure for Involute Serrations. These are now incorporated as Table 13 of the Standard. For easy calculation of all fits, new basic measurements between and over pins have been included, and also new tables giving the maximum tooth space and the minimum tooth thickness.

The pitches included are 10/20, 16/32, 24/48, 32/64, 40/80, 48/96, 64/128, 80/160 and 128/256, complete from 6 to 100 teeth only for the first three. The Scope is from .10 diameter to 10.00 diameter. The pressure angle for all serration is 45°. Serrations are based upon involute form as generated with a straight sided hob of the form included in this Standard. The basic dimensions are: Diametral Pitch, Pitch Diameter, Circular Pitch, Major and Minor Diameters and Addendum (of External Serration). Special dimensions are for circular tooth thickness and width of space, and both major and minor diameter of the internal serration.

TWIST DRILLS B5.12—1950 $ .75

To bring this Standard in line with current practice tolerances have been set on the various features of drills so that the products of different manufacturers will be interchangeable in the user's plants; taper shank drills have been included; the sequence of diameters of straight shank drills has been changed to correspond to the actual sizes purchased and used in industry; and the lengths of number, letter, and fraction size drills have been changed so that all three series have corresponding lengths.

Dimensions given are for standard straight shank drills varying in diameter from 0.0135 to 2.000 in.; taper shank drills from $^{1}/_{8}$ in. to $3^{1}/_{2}$ in.; the corresponding drill lengths and flute lengths; and the tolerances on drill diameter, shank diameter, back taper, overall length and flute length. Tools are defined and illustrated.

UNIFIED AND AMERICAN SCREW THREADS STANDARD Second Edition B1.1—1949 $3.00

Incorporated in this recently published Second Edition are the recent amendments which were made to prevent possible misinterpretations of text or illustrations, to facilitate the use of the tables, and to correct some misprinted figures. Specifically the Standard presents the coarse thread series for sizes from $\frac{1}{4}$ in. to 4 inches and the fine thread series from $\frac{1}{4}$ in. to $1\frac{1}{2}$ inches diameters in the unified screw threads; the 8-, 12-, and 16-thread series of the 1935 American Standard with an extra fine series added; six new tolerance classes known as 1A, 2A, and 3A for externally threaded components and 1B, 2B, and 3B for internal threads with the same allowances on 1A and 2A. The diameter pitch combination of the unified coarse and fine thread series are the same as in 1935 standard except that the pitch of the $\frac{1}{2}$-in. coarse thread is now 12, and the 1-in. fine thread is also 12. The $\frac{1}{2}$-in. 13 coarse thread and the 1-in. 14 fine thread are retained as optional American Standards. Classes 2 and 3 with no allowances and like tolerances for external and internal threads are continued as American Standards but are expected to be superseded by the new unified classes. Concluding the Standard are the eight appendixes presenting definitions of terms and symbols used, formulas from which values in the tables are derived, tables for old Class 1, and a considerable amount of the useful and supplementary information.

20-DEGREE INVOLUTE FINE-PITCH SYSTEM FOR SPUR AND HELICAL GEARS B6.7—1950 $1.50

This new American Standard closely follows the 1932 Spur Gear Tooth Form Standard with a slight increase in the whole depth to allow for the greater proportional clearance necessary in fine-pitch gears. The series includes gears of 20-diametral pitch and finer having a 20-degree pressure angle. The range of pinion sizes has been extended down to 7 teeth because pinions of this size are used in many servo-mechanisms. Standard tooth proportions and formulas are included, also dimensions required when using enlarged pinions. Data are given: for enlargement of helical pinions of 20-deg normal pressure angle; to show the permissible reduction in outside diameter of gears from 20 to 200 diametral pitch; and to cover the design of spur and helical pinions having 9, 8, and 7 teeth. All symbols used are defined.

For Incorporation in the Specifications You Use

SINGLE POINT CUTTING TOOLS AND TOOL POSTS B5.22—1950 $1.25

Besides being a complete revision of the 1939 Standard on Terminology and Definitions for Single Point Tools and the 1943 Standard on Tool Shanks and Tool Posts, this 1950 Edition contains a considerable amount of new material. Specifically, it defines and illustrates the different classes of tools, the parts of those tools, and the angles at which they are used. It gives the standard dimensions for tool shanks, tool post openings, and lathe center height for solid tools and tool holders. In the new sections of the Standard single point tools are listed and classified according to their shape, construction or use; the sizes of the six styles of sintered carbide tips, which have been adopted by the carbide manufacturing industries and the commercial catalog numbers are given; also the dimensions of tips and shanks for single-point tipped tools with 0° and with a 15° side-cutting edge angle; of square-end tools; of 80° and 60° nose-angle tools; and of off-set end-cutting and side-cutting tools.

FINE-PITCH STRAIGHT BEVEL GEARS B6.8—1950 $1.00

This new American Standard was developed to cover generated straight bevel gears: (a) of 20 diametral pitch and finer, (b) for all shaft angles, and (c) with the numbers of teeth equal to or greater than 16/16, 15/17, 14/20, 13/30 for 90-deg shaft angle. Tables give general dimensions; the tooth proportions for 1 diametral pitch; the recommended tolerances for outside diameter, crown to back, and face angle; and fine-pitch straight bevel dimensions. Sketches show the important bevel gear blank dimensions and application of tolerances of bevel gear blanks.

The Standard is identical in technical content with the AGMA Standard on Fine-Pitch Straight Bevel Gears. It follows the same general principles of the 20-deg Involute Fine-Pitch System. The tooth proportions are similar to those given in the AGMA Standard on Straight and Spiral Bevel Gears with the following modifications: Clearances are increased. Tooth thicknesses correspond to those generated by a crown gear in which the tooth thickness and space width are equal. The maximum face width is limited to three tenths of the cone distance, or $\frac{8}{P}$ in., whichever is smaller.

DESIGN FOR FINE-PITCH WORM GEARING B6.9—1950 $1.50

As the title implies, this new Standard is intended as a design procedure. It covers worms and worm gears with axes at right angles, comprising cylindrical worms with helical threads, the worm gear being hobbed for fully conjugate tooth surfaces.

It supplies the standard proportions of worms and worm gears, values of diameter for all possible combinations of leads and lead angles within the Standard, and tooth proportions based on normal pitch for all combinations of standard axial pitches and lead angles. An extensive table gives the difference in departure from a straight side of the worm profile and the changes in pressure angle produced by cutters or grinding wheels of 2-in. and 20-in. diameters. (Values in this table are diagrammatically illustrated.) Examples of fine-pitch worm and worm gear calculations are included to assist the designer in using the standard. Sketches show (1) throated worm gear blank (for power drives) and (2) non-throated worm gear blank (for transmission of motion).

PUNCH AND DIE SETS FOR TWO-POST, PUNCH PRESS TOOLS B5.25—1950 $ .75

This design and dimensional standard covers the types and range of sizes in general demand by tool designers and used by tool makers for the mounting of punch press tool details.

The two series for which standards are set up consist of back-post regular and reverse, and round and rectangular diagonal-post sets. Although these sets are of the conventional type with pressed-in guideposts and guidepost bushings, the standardized die areas may also apply to die sets having patented mountings for the guideposts and bushings. Six tables give dimensions of: the die area, the die holder and punch holder thickness, the minimum guidepost diameter, shank diameters and lengths, guideposts, guidepost bushings, and removable punch holder shanks. Because the styles and the progressive range of sizes meet the largest volume of needs of users, they may be manufactured on a continuous production basis. Furthermore, tolerances have been established that will assure a high grade of tools which can be maintained commercially in respect of the component parts and assembly.

20% Discount to ASME Members

The American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

Puzzle for experts

There is no need for "cutting and trying" on the job to make a prefabricated piping sub-assembly fit perfectly. Prefabricated miles away to exact dimensions and specifications these pieces of piping are links in piping systems which may carry steam up to 2500 p.s.i. and 1050°F.

Grinnell integrates the many factors in this complex, highly technical assignment in one organization of specialists. Major economies result from this single responsibility which includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

You'll find it to your own best interests to draw upon Grinnell's century-long, specialized experience in power, process and industrial piping.

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Farval provides perfect lubrication for world's largest tin dredges

THE bearings on the digging ladders of these dredges are subject to heavy shock loads and continuous vibration. For days at a stretch they are immersed in corrosive salt water, in the excavation of tin bearing sand. Yet the bearings function perfectly because each one is protected by a tough, unbroken film of lubricant supplied by Farval Centralized Lubricating Systems.

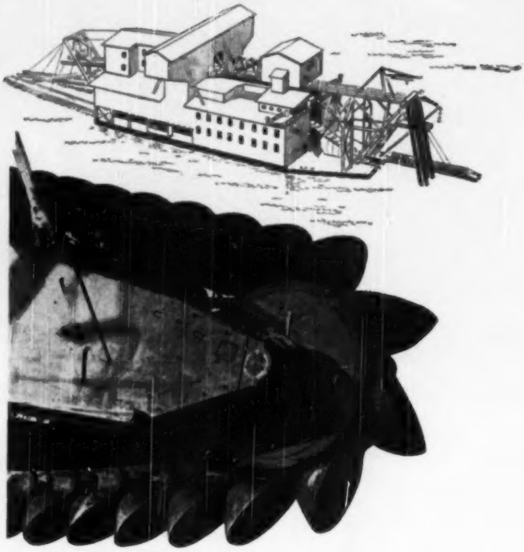
The tin dredge pictured here is one of nine such Farval-protected giants operating in the Dutch East Indies. Its digging ladder is 216 feet long, operates 100 feet under water. The super structure stands as high as a 9-story building. Other similar recently built mining dredges, lubricated by Farval, dig for gold in Africa, Russia and the American west—nearly a score in all.

Where expensive, heavy-duty bearings must function continuously under heavy loads, or in any difficult conditions—where success depends on adequate protection of bearings—there you'll find Farval on the job. On thousands of machines all over the world, Farval Centralized Lubrication has long since proved its ability to save labor, lubricant and time, eliminate delays, reduce maintenance expense and repairs, and increase production.

Farval is the original (patented) Dualine system of centralized lubrication that has proven itself through years of service. The Farval valve has only two moving parts—is simple, sure and fool-proof, without springs, ball-checks or pinhole ports to cause trouble. Through its full hydraulic operation, Farval unfailingly delivers grease or oil to each bearing—as much as you want, exactly measured—as often as desired. Indicators at every bearing show that each valve has functioned.

Write for Bulletin 25 for full details. The Farval Corporation, 3264 East 80th St., Cleveland 4, O.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.



FARVAL—*Studies in Centralized Lubrication* No. 114

FARVAL
CENTRALIZED SYSTEMS OF LUBRICATION

MECHANICAL ENGINEERING
CARD INDEX

July, 1950 — Vol. 72, No. 7

FOSTER WHEELER

Outdoor Unit for the

MONTANA POWER COMPANY

at Billings, Montana

Model of plant

Capa[illegible]

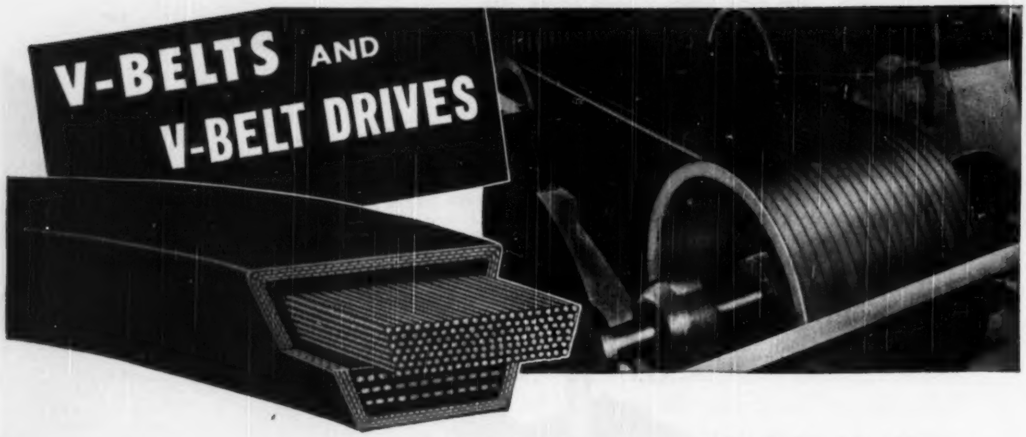
Superheat Co[illegible]

Pressure Superheater [illegible]

Final Steam Temperature.... [illegible]

165 BROADWAY, NEW YORK 6, N. Y.

FOSTER FW WHEELER



Power Transmission Equipment Engineers and Manufacturers since 1857.

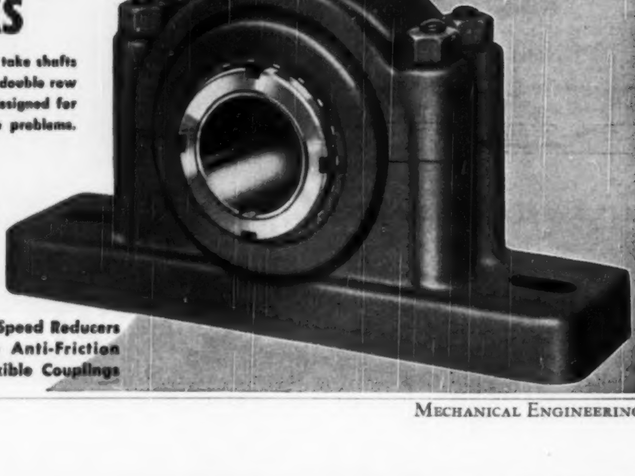
Matchability of Wood's "Sure-Grip" V-Belts and V-Belt Sheaves assures a balanced drive performance. The positive locking effect—achieved as the "tailored to the groove" v-belts seat themselves in the smooth, uniform sheave grooves—assures higher operating efficiency, smoothness at all belt speeds, greater load capacity, ability to absorb shock and pulsating loads, minimum maintenance and lowest power consumption. Write for detailed information.

T. B. WOOD'S SONS COMPANY, CHAMBERSBURG, PENNA.

Branches: Boston, Mass., Newark, N. J., Dallas, Tex., Cleveland, O.

Jones

ROLLER BEARING PILLOW BLOCKS



JONES Pillow Blocks are made in sizes to take shafts 15/16" to 9" in diameter. Equipped with double row Timken roller bearings. Engineered and designed for the most efficient solution of your drive problems. Ask for Bulletin No. 86.

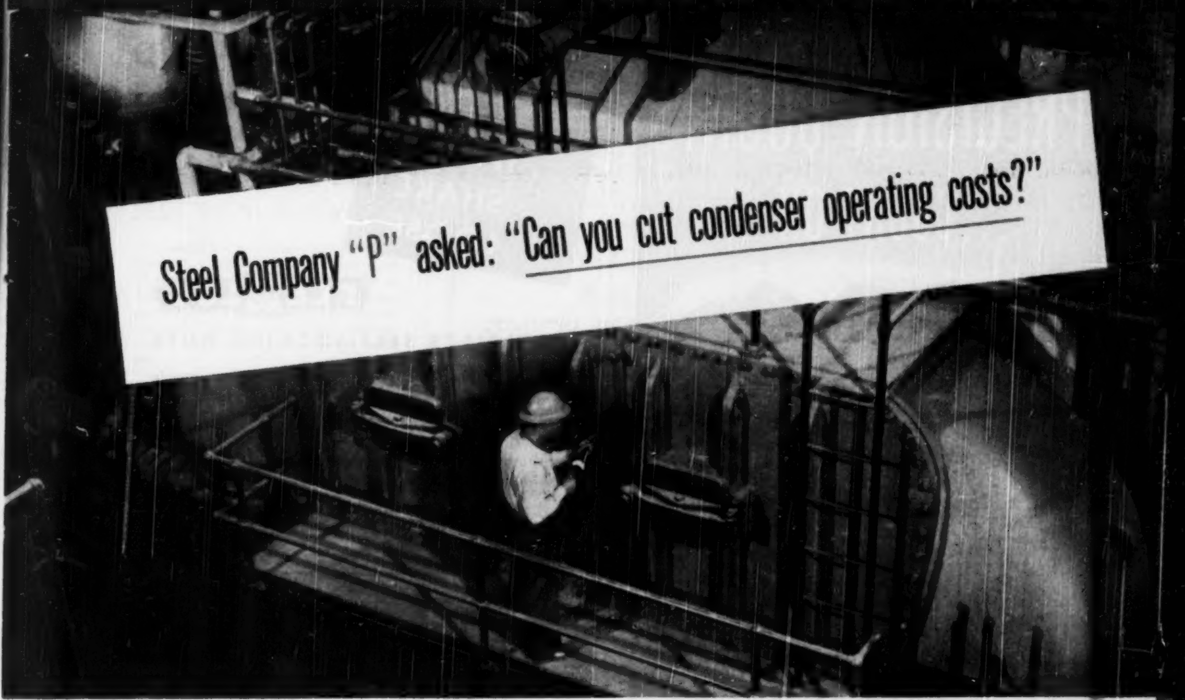
W. A. Jones Foundry & Machine Co.
4427 W. Roosevelt Rd., Chicago 24, Ill.

Since 1890
Jones
In the Service of Industry

Herringbone — Worm — Spur — Gear Speed Reducers
Pulleys · Gears · V-Belt Sheaves · Anti-Friction
Pillow Blocks · Friction Clutches · Flexible Couplings

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



Dowell Service saved $87.92 in steam per day!

Dowell Service was used by a major steel company to clean a large turbo blower condenser. After the cleaning, operating figures showed a saving in steam of 8000 lb. per hour or a dollar saving of $87.92 per day. At this rate, *Dowell Service paid for itself in 5½ days!*

There are many places in every industrial plant where Dowell Service can be used to cut operating costs. Wherever deposits on the surfaces of condensers, boilers, heat exchangers, water lines and other equipment are stealing power, Dowell Service can show money-saving results.

Dowell Service has another prime advantage for the maintenance engineer. *It is fast!* Because cleaning is done chemically, time-consuming dismantling is eliminated. Dowell engineers fill the equipment with liquid solvents that go wherever steam and water flow. These solvents are designed to remove deposits quickly, efficiently and economically.

Do you have a cleaning problem, too . . . a place where deposits are causing a maintenance headache? Call Dowell. Skilled cleaning engineers are available for consultation at no obligation.

Other recent Dowell jobs:

In a large textile plant, the heating time required in kier heaters was cut one-third, following cleaning with Dowell Service.

•

Houdry catalyst cases cleaned by Dowell Service for a large refinery showed all tubes to be practically metal clean and orifices opened.

•

Thirty-three year old water well, cleaned by Dowell Service, showed increase from 64 to 130 g.p.m. with drawdown decrease of 27 feet.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
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Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

OPPORTUNITIES

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

MECHANICAL AND ELECTRICAL ENGINEERS

Long-established manufacturer located in south Central New York State, producing large volume of electro-mechanical devices, has several attractive, permanent positions for experienced men interested in creative design, development and production engineering. Furnish complete resumé of training and experience when applying.

Address CA-3259, care of "Mechanical Engineering."

RESEARCH POSITIONS

Physicists and Engineers with advanced experimental and theoretical experience in

- **Nuclear Technology**
- **Solid State Physics**
- **Physical Metallurgy**
- **Power Plant Components**

are desired for research and development work on direct contract with the Reactor Division of the Atomic Energy Commission.

These positions offer unique opportunities for working with a highly trained group of scientists and for participating in theoretical and experimental studies in nuclear reactor technology. The laboratory is located in the Los Angeles area.

Please write to:

NORTH AMERICAN AVIATION, Inc.

Attention: Personnel Manager

ATOMIC ENERGY RESEARCH DEPARTMENT

**12214 South Lakewood Blvd.
Downey, California**

Opportunities for MECHANICAL AND ELECTRICAL ENGINEERS

Several positions available in Aeronautical Division of large, well known company for Mechanical and Electrical Engineers. Located in Middle West. Only those with high qualifications and some experience in design and development, production, or application engineering may be considered. Please send detailed resumé.

Address CA-3258, care of "Mechanical Engineering."

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PHYSICISTS AND SENIOR RESEARCH ENGINEERS

• • •

POSITIONS NOW OPEN

Senior Engineers and Physicists having outstanding academic background and experience in the fields of:

- **Microwave Techniques**
- **Moving Target Indication**
- **Servomechanisms**
- **Applied Physics**
- **Gyroscopic Equipment**
- **Optical Equipment**
- **Computers**
- **Pulse Techniques**
- **Radar**
- **Fire Control**
- **Circuit Analysis**
- **Autopilot Design**
- **Applied Mathematics**
- **Electronic Subminiaturization**
- **Instrument Design**
- **Automatic Production Equipment**
- **Test Equipment**
- **Electronic Design**
- **Flight Test Instrumentation**

are offered excellent working conditions and opportunities for advancement in our Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:

NORTH AMERICAN AVIATION, INC.

AEROPHYSICS LABORATORY

Box No. H-4

12214 South Lakewood Blvd.

Downey, California

MECHANICAL ENGINEER

For Mechanical Design and Engineering Studies in connection with Electric Utility work. Should have 15 years' experience in similar work.

Write to: Mechanical Engineer, Pennsylvania Power & Light Company, Allentown, Pennsylvania.

See Advertisements on next page

DEVELOPMENT ENGINEER

Large Chicago manufacturer requires a Development Engineer to supervise original development and design work on heavy automatic machinery. Must assume full responsibility for projects. Mechanical or electrical engineering degree required with five to fifteen years' experience. In reply, please state age, education, experience and salary requirements. Replies held confidential.

Address CA-3255, care of "Mechanical Engineering."

MECHANICAL DESIGN ENGINEER

B.S. or advanced degree with 5 to 10 years' experience in design and development of miscellaneous mechanical apparatus such as farm implement, materials handling, packaging and special automatic machinery fields. This is a position of high potential with a 105-year-old company located in Michigan. Requires high creative design ability and qualities of leadership. Submit full details in confidence.

Address CA-3268, care of "Mechanical Engineering."

PRODUCT DESIGNER

M.E. or architect degree with knowledge of materials and production methods. Requires 5 to 10 years of static design experience. Furniture or office equipment experience desirable. This is a position of high potential with a 105-year-old company located in Michigan. Requires initiative, resourcefulness and creative ability. Submit full details in confidence.

Address CA-3260, care of "Mechanical Engineering."

RESEARCH MECHANICAL ENGINEER

Long-range research program of large and progressive manufacturer of air conditioning and refrigeration equipment requires services of mechanical engineer with demonstrated record of creative achievement.

Requirements include excellent fundamental training in heat transfer and fluid flow; experience in research and development of mechanical devices and heat exchange equipment; and the personal qualifications necessary to organize and carry through a program of applied research from general assignment to successful commercial application.

Age from 30 to 45. Salary commensurate with experience and qualifications. Location Central New York.

Please write, stating education, experience, age, record of accomplishment and invention, and salary desired.

Address CA-3270, care of "Mechanical Engineering."

Continued on Page 90

Two Pages of "OPPORTUNITIES" This Month . . . 89-90

POSITIONS OPEN

Continued from Page 89

Needed Immediately in Texas

ASSISTANT CHIEF

TOOL ENGINEER

To assist in the administration of all tooling activities for a major Company. Must be a graduate mechanical engineer with extensive practical tooling and administrative experience.

PRODUCTION SCHEDULING AND ORDERING

GENERAL SUPERVISOR

Must have had at least six years of administrative or supervisory experience, manufacturing and control of a large manufacturing organization.

Mail written detail outline of your experience and qualifications.

Address CA-3278, care of "Mechanical Engineering."

PIPING DESIGNER

Excellent opportunity in well-known oil refinery company. Graduate engineer preferred.

Must have heavy experience in oil refinery, chemical plant or power plant piping.

Write details of education and experience.

Address CA-3272, care of "Mechanical Engineering."

MACHINE TOOL DESIGNERS

top quality only. Nationally known products, good working conditions, opportunity for advancement. Salary open. Ohio.

Address CA-3279, care of "Mechanical Engineering."

Use a CLASSIFIED ADVERTISEMENT
For QUICK Results

DESIGN ENGINEER

with broad experience in the Diesel Engine field. Nationally known products. Opportunity for advancement. Salary open. Southern Ohio.

Address CA-3280, care of "Mechanical Engineering."

PRESSURE VESSEL DESIGN ENGINEER

Excellent opportunity in well-known oil refinery company for graduate engineer with heavy experience in design and development.

Familiar with ASME and API Codes and the work of the Pressure Vessel Research Committee. Knowledge of vessel fabricator's shop practices and metallurgy including welding of carbon and alloy steels.

Write details of education and experience.

Address CA-3273, care of "Mechanical Engineering."

CONCRETE DESIGNER

Excellent opportunity in well-known oil refinery company for graduate Civil Engineer.

Must have heavy experience in design of foundations and structures.

Write details of education and experience.

Address CA-3274, care of "Mechanical Engineering."

MECHANICAL ENGINEERS—College teachers—Automotive, Mechanics, Thermo, others. All ranks to Dept. Heads, $8000. Give Phone, Photo, Qualifications. Cline Teachers Agency, East Lansing, Mich.

FACTORY JOB ANALYST—To analyze, describe and evaluate machine shop and assembly work for wage determination and Industrial Relations purposes. Excellent opportunity to learn company organization and operations. Good training for wage administration, industrial relations or factory management positions. Must have experience as machine operator or machine shop job analyst. Degree in Engineering preferred. Please send full particulars in writing, stating complete detailed background and salary expected to: J. Arthur Johnson, Personnel Manager, Minneapolis-Honeywell Regulator Co., 2753 Fourth Avenue So., Minneapolis 8, Minnesota.

ESTIMATOR—Capable of running department—with minimum of 15 years' contracting experience, estimating heating, ventilating, power and air conditioning work. State salary and experience. Replies confidential. Address CA-3281, care of "Mechanical Engineering."

SALES-MINDED ENGINEER—Young mechanical engineering graduate to work into Sales Engineering. Old established manufacturer of construction and processing equipment. Knowledge of sand and gravel processing, ore treatment and coal preparation helpful. Excellent opportunity. Write stating education and experience. R. L. Aulmann, Box 934, Des Moines, Iowa.

ENGINEER—for Plant Engineering. Experienced in pulp and paper mill maintenance, and small to medium size power plants. Design ability on general plant problems. Some traveling. Location Ohio. Address CA-3262, care of "Mechanical Engineering."

Montana State College has a few openings in its RADIANT HEATING LABORATORY for graduate students wishing to obtain a Master's Degree and interested in the field of residence heating (Master's degree obtainable in one year). Out-of-state fees are approximately $35 per quarter. Limited financial help available for part-time laboratory assistants. Write Head, Mechanical Engineering, Montana State College, Bozeman, Montana.

ASSISTANT GENERAL MANAGER—Plant doing heavy and light pressing and fabrication of plate, heavy sheet and alloys; personnel approximately 800 in this division of plant. Must be thoroughly familiar with heavy hydraulic pressing operations; graduate M. E. or equivalent in experience, with 10 years or more actual operating know-how. Preferred age 35–45. Man to be chosen will be one with promotional possibilities. State experience, present position and salary requirements in first letter. Address CA-3277, care of "Mechanical Engineering."

POSITIONS WANTED

MECHANICAL ENGINEER—P.E., Graduate, Member ASME, wellrounded background of 11 years of responsible charge of design of power plant, chemical plant and refinery piping, equipment, exchangers and systems; also some heating and ventilating and some construction; desires changing present position to one with progressive plant or equipment manufacturer on permanent basis. Salary $6500-7000. Location near New York City preferred. Address CA-3257, care of "Mechanical Engineering."

REGISTERED MECHANICAL ENGINEER—26 years' diversified experience in College teaching, consulting and industry. Formerly head of department of mechanical engineering in a major university. Presently engaged in research and development with the Federal Government. Interested in a responsible position in College or industry. Address CA-3256, care of "Mechanical Engineering."

MECHANICAL ENGINEERING GRADUATE—30, single, veteran, good scholastic record, fifteen months general engineering experience, four years' diesel experience in navy. Desires permanent connection with future in any phase of mechanical engineering. Prefer location in S. E. Address CA-3263, care of "Mechanical Engineering."

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MECHANICAL ENGINEER—Age 33, Experienced Aircraft, industrial Equipment, construction design installation, maintenance. Desires position in South America. Address CA-3266, care of "Mechanical Engineering."

MECHANICAL ENGINEER, BS, ME, ASME, ASH & VE. Age 33, family; formerly Lt. Commander. Factory training in Air Conditioning, Pumps and Steam specialties. Desires position sales representative or Industrial Engineer. Now employed in N.W. Address CA-3265, care of "Mechanical Engineering."

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RECENT PRATT GRADUATE—B.M.E., 25, Single, Sheet metal drafting background. Desires trainee or junior engineer position in design, development or research. Will locate anywhere or travel. Address CA-3276, care of "Mechanical Engineering."

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This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions, assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited.

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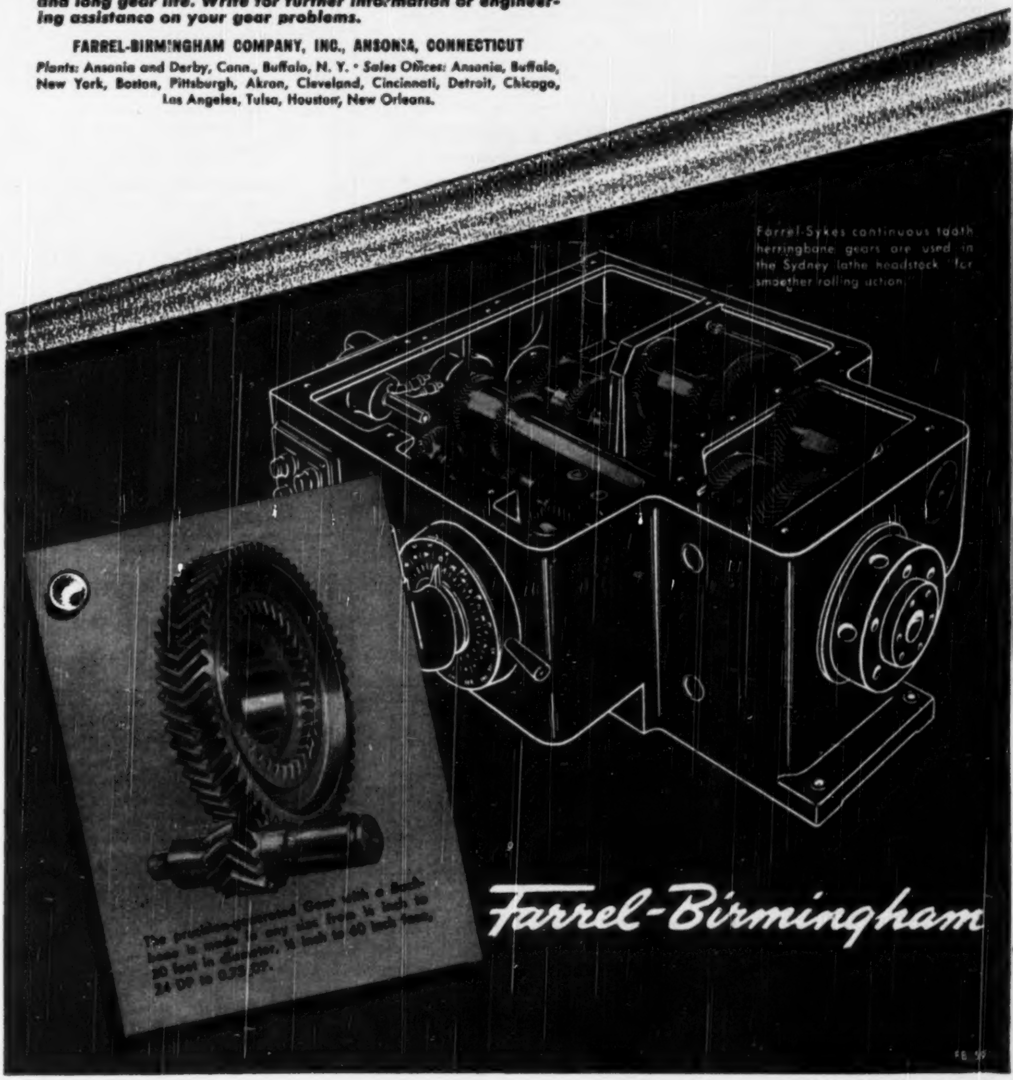

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Index To Advertisers

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The asterisk indicates that firm also has product catalog in the 1950 A.S.M.E. Mechanical Catalog and Directory

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ENGINEERING SERVICE . . . Page 92

Advertisers in previous 1950 issues but not in this issue

MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

Additional information is requested on the following advertisements in the August 1950 issue.

Page No.	*Name of Advertiser*

Name ______________________ Title ______________________

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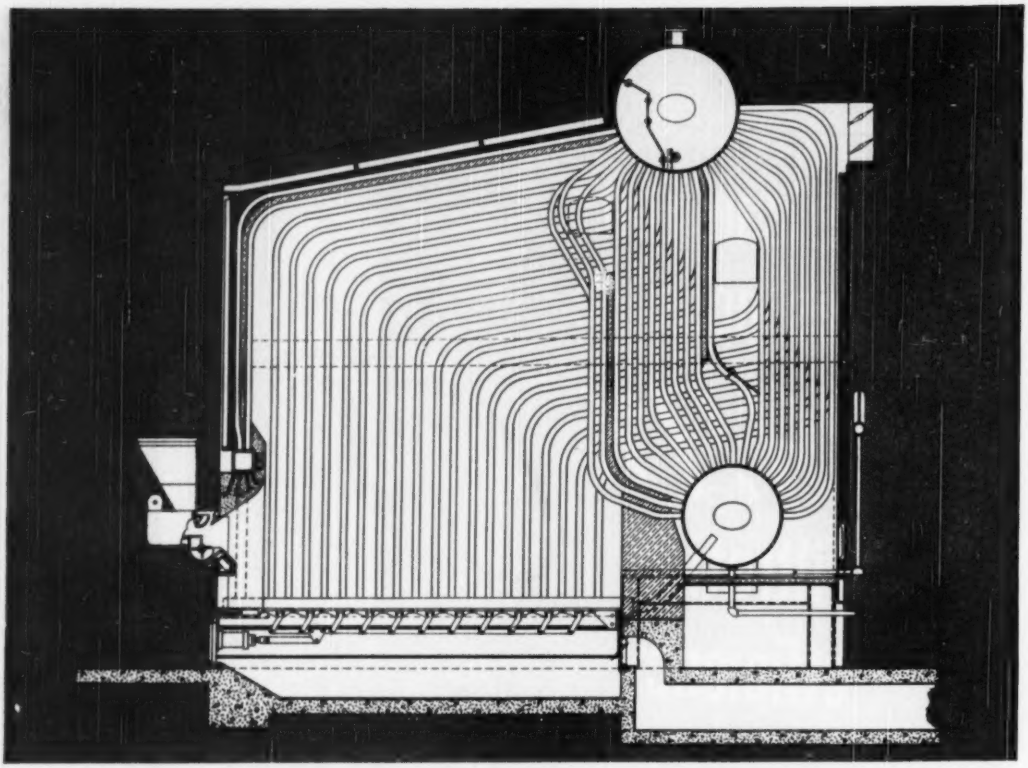

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COMBINING BOILER • WATER WALL FURNACE • INSULATED STEEL CASING

ERIE CITY concentrates high capacity into small space. The V-C Steam Generator has complete water cooling of top, sides and front, integral with a 2-drum boiler.

GAS travel is symmetrical about the center line of the unit.

WATER circulation is ring flow.

ONE or two internal steam separators, as required, assure clean, dry steam.

THE entire unit is supported from bottom members, thus allowing free expansion upward of the entire unit. All exterior walls consist of insulated steel panels, independently suspended, a construction similar to that of our largest central station steam generators.

ANY tube can be replaced without disturbing any other tube.

THE above illustration shows an Erie City Spreader Stoker fired V-C unit, utilizing a water cooled plastic arch, molded around the front header.

THE Erie City V-C Steam Generator is available in a wide range of capacities for varying space limitations and for all firing methods. Write for bulletin 37.

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COMPLETE STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

DeVlieg Jigmil bores precision holes in jig time on TIMKEN® bearings

PHOTO below shows the DeVlieg Machine Company's 3-B Jigmil in action at Towmotor's Cleveland plant, boring holes for transmission housings. A fast, precision boring job is insured by the Timken® bearings on the spindle and by the 40 other Timken bearings used throughout the machine.

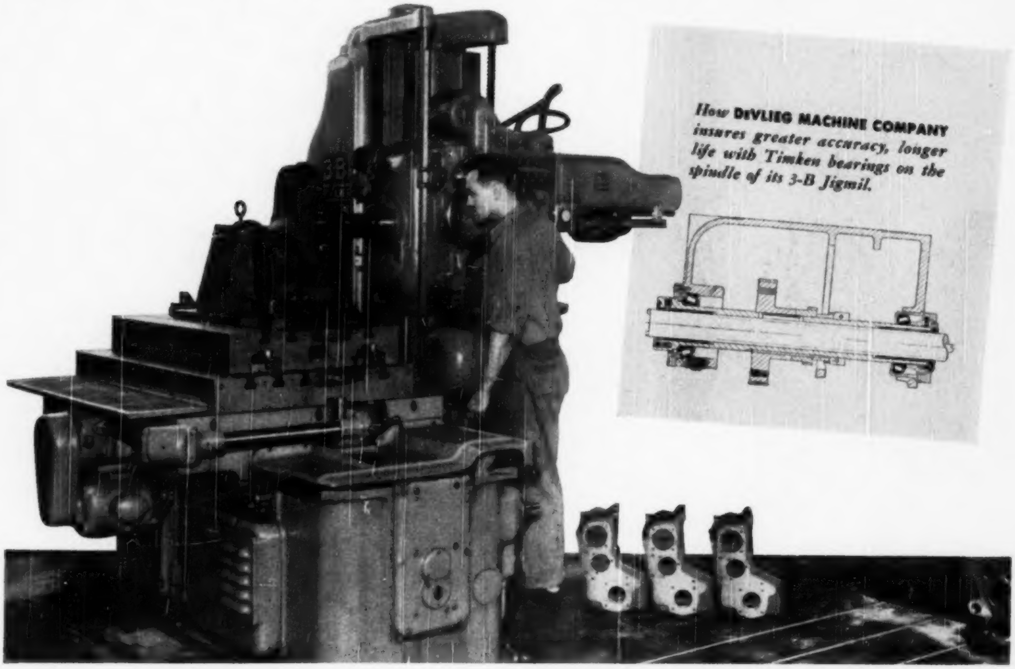
Timken bearings assure greater accuracy and speed by keeping shafts rigid, yet free to rotate with negligible friction. They minimize deflection and end-movement. They lengthen machine life by reducing wear on gears and other adjacent parts.

Because Timken bearings have line-contact between rollers and races, they can carry greater loads. And their tapered construction takes both radial and thrust loads in any combination, permits preloading to any desired degree.

Timken bearings are built for long, tough service. They're made of special analysis Timken fine alloy steel and manufactured to amazing limits of accuracy.

This combination of advanced design and quality construction has made Timken bearings first choice throughout industry. That's why Timken bearings are a valuable added sales feature for your product. Make sure the trade-mark "Timken" is on the bearings you buy. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



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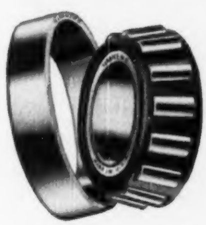

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